No. SM-E3255-0A
Date JUNE, 1983

SERVICE MANUAL

MARINE RADAR

MODEL 2400

FURUNO ELECTRIC CO., LTD.
NISHINOMIYA JAPAN

PRINTED IN JAPAN

WARNING AGAINST HIGH TENSION

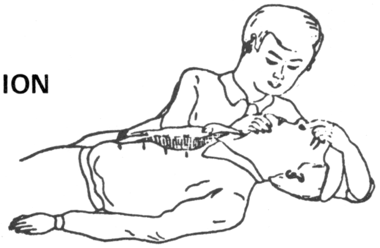
The operation of this equipment involves the use of high voltage, which endangers human life. Although the design of the equipment has been made in due consideration of measures to insure the operator's safety, adequate precaution must be exercised when reaching inside the equipment for the purpose of maintenance and service. Do not change a component or inspect the equipment with the voltage applied. A residual charge may exist in some capacitors with the equipment turned off. Always short all supply lines to the chassis with an insulated screwdriver or a similar tool prior to touching the circuit.

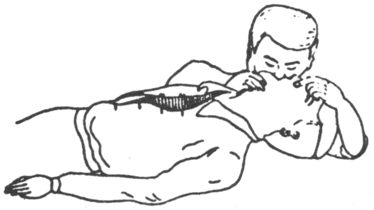
FIRST AID IN CASE OF ELECTRIC SHOCK

When a victim struck by electricity is found, first switch off the equipment via the main switch on the equipment or the ship's distribution board. If this is not possible, protect yourself with dry insulating material (a wooden plate or rod, cloth, your belt, etc.) and pull the victim clear of electricity. If the victim is not breathing himself, apply artificial respiration according to the "Method of Artificial Respiration". Do not give up halfway. Perseverance and continual efforts are important in artificial respiration.

METHOD OF ARTIFICIAL RESPIRATION

Lay the victim on his back. Position yourself beside the victim's head and pinch his nose by your thumb and forefinger to prevent air leakage. Insert the thumb of your other hand between the victim's teeth and lift his chin up. Then, place the arm (the one closing the victim's nose) on the victim's forehead and press the head down so that the victim's head is given a maximum backward tilt with the chin prominent and the neck bent back. Seal the victim's mouth with your mouth and blow therein about half of the deeply inhaled air every time. After exhaling, turn your head to watch for a chest contraction, whilst inhaling deeply in readiness for the next blowing. Repeat the movements faster for the first 1 to 2 minutes and 12 times per minute thereafter.





WORK ON THE SCANNER UNIT

In many cases an incidental accident worsens a casualty of electric shock. Secure a solid foothold when working at an elevated spot.
Remove the scanner fuse or take other adequate safety measures before going to the scanner unit to prevent a third man from rotating the scanner.

GENERAL CONTENTS

INTRODUCTION

PART 1 ---------------------------- DISPLAY UNIT

PART 2 ---------------------------- SCANNER UNIT

PART 3 ---------------------------- SYSTEM MAINTENANCE & TROUBLESHOOTING

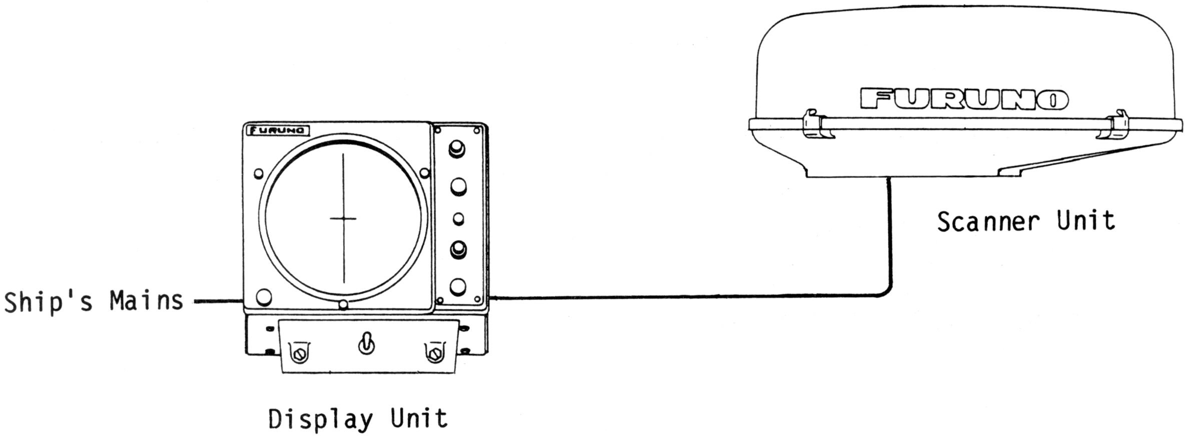
INTERCONNECTION DIAGRAM

RECOMMENDED SPARE PARTS LIST

INTRUDUCTION

The MODEL 2400 radar is compact, high performance X-band marine radar designed for small coastal boats and pleasure craft.

The system consists of the 7" display unit and the radome scanner and operates directly from 11 to 40VDC ship's mains. For operation from 110/220VAC, an additional rectifier unit is used.



DISPLAY UNIT

The display unit can be table-top, bulkhead or overhead mounted with its reversible mounting cradle. The plug-in interconnecting cable permits quick removal of the display unit for taking ashore or use on the flying bridge.

Range scales are 1/4, 1/2, 1-1/2, 3, 6, 12, 24 n.m. Radar images are bright and of excellent resolution due to high pulse repetition frequency. The rotatable cursor is graduated 0-360 degrees at 1 degree intervals. By placing the cursor line on a target, the bearing is read in line with the heading marker. The heading marker can be momentarily erased.

SCANNER UNIT

The 80cm long center-fed waveguide antenna is encapsulated, together with the transceiver electronics and turning mechanism, in the robust plastic radome. Totally new turning mechanism operates with the least mechanical sound and permits antenna installation anywhere on the bridge.

The output power is 3kW with a pulse repetition rate of 3400 or 800Hz, automatically switched with the display range, and the pulselength is also switched on either 0.08 or 0.5 microseconds. Horizontal beam width is 2.7 degrees, narrowest in this class of radars. The transceiver circuitry includes a totally new microwave IC.

SPECIFICATIONS

SCANNER UNIT

1. Radiator:	80 cm center-fed slotted waveguide array, enclosed in radome
2. Radiator Rotation:	24 r.p.m.
3. Wind Load:	Relative wind 100 knots
4. Horizontal Beamwidth:	2.7°
5. Vertical Beamwidth:	25°
6. Sidelobe Attenuation:	Within ±20° of main lobe; 21 dB Outside ±20° of main lobe; 25 dB
7. Polarization:	Horizontal
8. Ambient Temperature:	–25°C to +70°C

RF TRANSCEIVER (Contained in the radome)

1. Transmitter Tube:	9M302/E3513 or MG5251
2. Frequency:	9410 ± 30 MHz (X-band)
3. Peak Output Power:	3 kW
4. Pulselength and Pulse Repetition Rate:	

RANGE	1/4, 1/2, 1-1/2	3, 6, 12, 24	n.m.
P/L	0.08	0.5	μsec.
P.R.R.	3400	800	Hz

5. Intermediate Frequency:	40 MHz
6. Bandwidth:	7 MHz (with 0.08μs pulselength) 3 MHz (with 0.5μs pulselength)
7. Duplexer:	Circulator and diode limiter
8. Modulator:	Solid state
9. Tuning:	Manual

DISPLAY UNIT

1. Picture Tube:	7" PPI Scope (12" presentation with magnifying lens)
2. Range Scales:	1/4, 1/2, 1-1/2, 3, 6, 12, 24 n.m.
3. Range Ring Interval:	1/8, 1/8, 1/4, 1/2, 1, 2, 4 n.m.
4. Range Discrimination:	Better than 25m
5. Range Accuracy:	1.5% or 70 meters, whichever is the greater
6. Minimum Range:	25 m
7. Ambient Temperature:	–15°C to +55°C

POWER SUPPLY

10.2 to 40VDC, 50W, directly.
100/110/115/220VAC ±10%, 50 to 60 Hz, 1φ, 70VA, with extra rectifier unit.

LAYOUT OF THIS SERVICE MANUAL

This Service Manual is made up of three parts;

PART 1 for DISPLAY UNIT,
PART 2 for SCANNER UNIT,
PART 3 for common items to both units such as
MAINTENANCE & TROUBLESHOOTING.

INTERCONNECTION DIAGRAM/RECOMMENDED SPARE PARTS LIST are attached at the end of this book.

PART 1 involves the circuit description, adjustment, removal and replacement of major components, technical data, parts location, electrical parts list, mechanical parts list, schematic diagram and mechanical parts exploded view only with respect to the display unit. PART 2 also involves the same items as above only with respect to the scanner unit. PART 3 supplies the system maintenance and troubleshooting for this radar system regarding to both display and scanner units.

This style of compilation will enable to consult quickly the items specific to the concerned unit.

PART 1

DISPLAY UNIT

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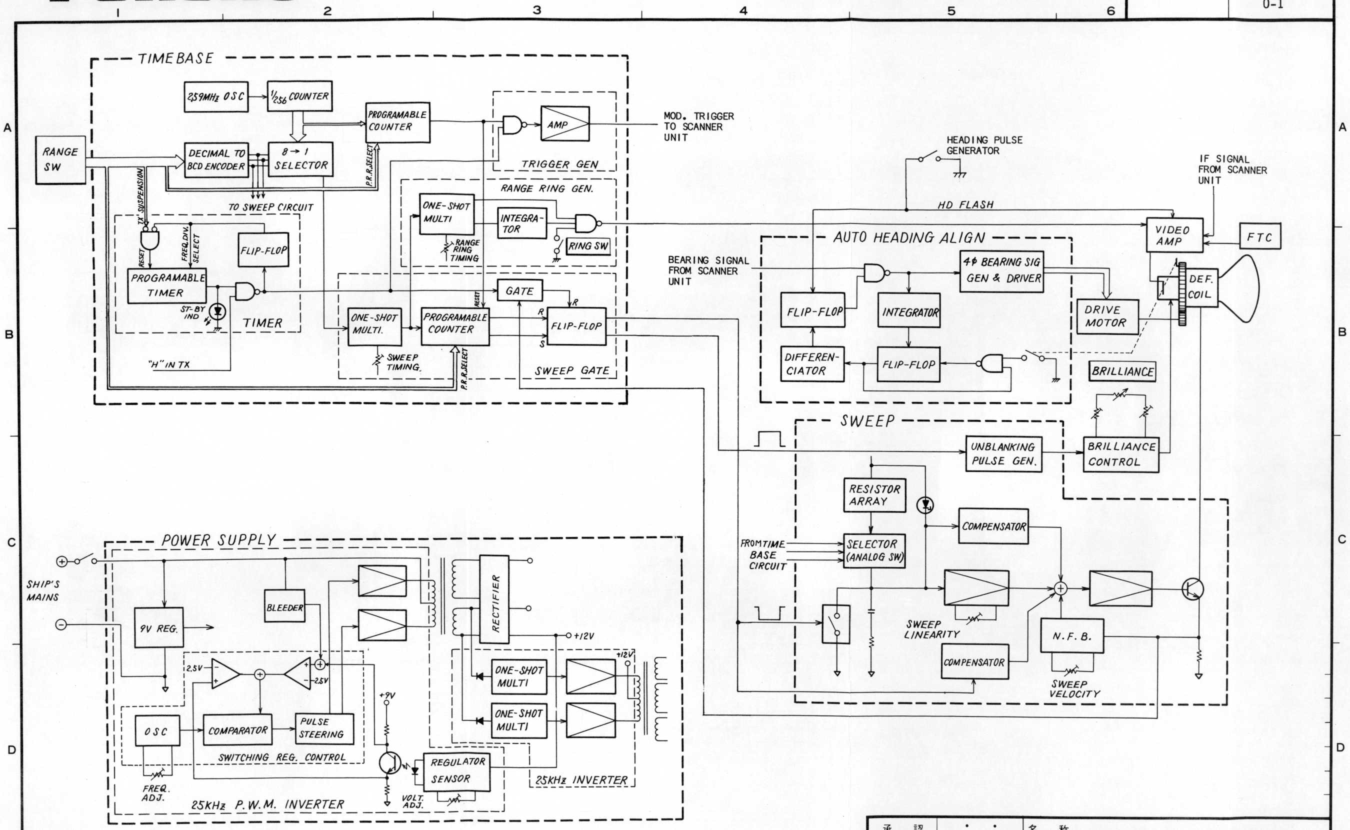
FURUNO

0-1


1
2
3
4
5
6
A
B
C
D
TIMEBASE
2.59MHz OSC
1/256 COUNTER
PROGRAMABLE COUNTER
AMP
MOD. TRIGGER TO SCANNER UNIT
TRIGGER GEN
RANGE SW
DECIMAL TO BCD ENCODER
8 → 1 SELECTOR
P.R. SELECT
TX SUSPENSION
TO SWEEP CIRCUIT
RANGE RING GEN.
ONE-SHOT MULTI
INTEGRATOR
RANGE RING TIMING
RING SW
RESET
FREQ. DIV. SELECT
FLIP-FLOP
PROGRAMABLE TIMER
ST-BY IND
TIMER
GATE
ONE-SHOT MULTI.
PROGRAMABLE COUNTER
RESET
R
S
FLIP-FLOP
SWEEP TIMING.
P.R. SELECT
SWEEP GATE
"H" IN TX
HEADING PULSE GENERATOR
HD FLASH
IF SIGNAL FROM SCANNER UNIT
VIDEO AMP
FTC
AUTO HEADING ALIGN
BEARING SIGNAL FROM SCANNER UNIT
4φ BEARING SIG GEN & DRIVER
FLIP-FLOP
INTEGRATOR
DRIVE MOTOR
DEF. COIL
DIFFERENCIATOR
FLIP-FLOP
BRILLIANCE
SWEEP
UNBLANKING PULSE GEN.
BRILLIANCE CONTROL
RESISTOR ARRAY
COMPENSATOR
FROM TIME BASE CIRCUIT
SELECTOR (ANALOG SW)
SWEEP LINEARITY
COMPENSATOR
N.F.B.
SWEEP VELOCITY
POWER SUPPLY
SHIP'S MAINS
9V REG.
BLEEDER
RECTIFIER
+12V
2.5V
-2.5V
+12V
ONE-SHOT MULTI
ONE-SHOT MULTI
+9V
OSC
COMPARATOR
PULSE STEERING
SWITCHING REG. CONTROL
REGULATOR SENSOR
FREQ. ADJ.
VOLT. ADJ.
25KHz INVERTER
25KHz P.W.M. INVERTER

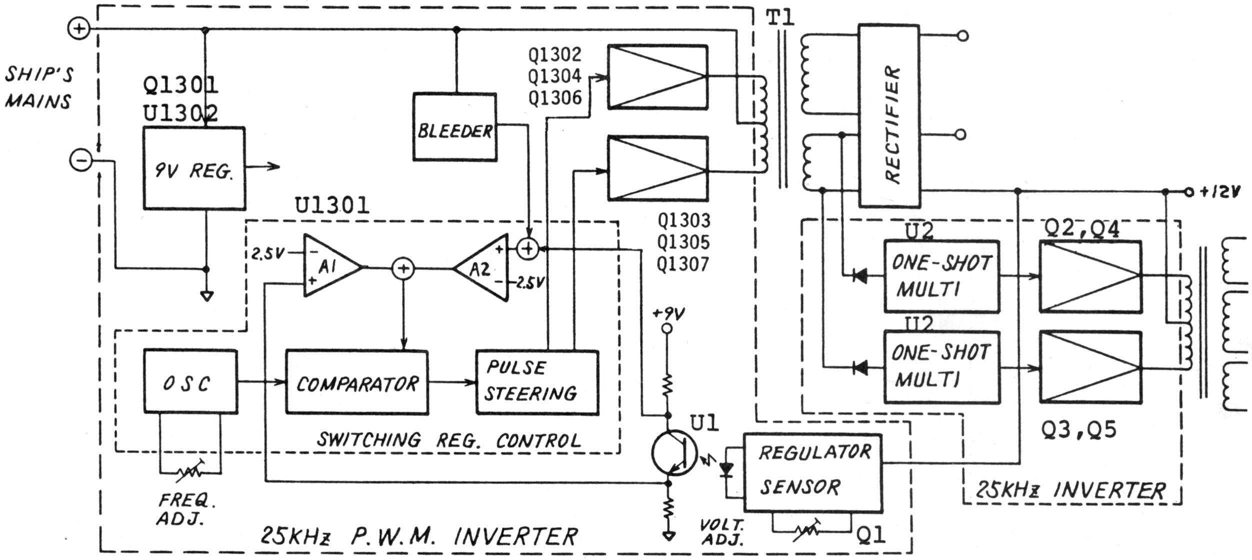
承 認 APPROVED	· ·	名 称 TITLE MODEL 2400/FR-240 MARK-III/ FR-360 MARK-II
検 図 CHECKED	· ·	BLOCK DIAGRAM OF DISPLAY UNIT
製 図 DRAWN	· ·	図 番 DWG. NO.

FURUNO ELECTRIC CO., LTD.

CHAPTER 1. CIRCUIT DESCRIPTION

1-1. Power Supply Circuit

The power supply circuit is made up of 25kHz PWM (Pulse Width Modulation) inverter employing switching regulation technique, 25kHz inverter driven by the output of PWM inverter, and protector.
The 25kHz PWM inverter operates universally on ship's mains of DC10.2 thru 40V. Against the variation of the mains voltage, it regulates the output dc line voltages by changing the width of its output pulse.
The 25kHz inverter is mainly for high tension lines. If high voltages are taken from the PWM inverter, the voltages induced on the transformer secondary windings become very high when the mains voltage is at the highest limit, say, nearly 40V, and the transformer is exposed to the danger of layer short. To avoid this, the high tension lines are separately generated in the 25kHz inverter which is driven by the regulated output of the PWM inverter. The block diagram of the power supply circuit is shown below.



⊕
SHIP'S MAINS
⊖
Q1301
U1302
9V REG.
BLEEDER
Q1302
Q1304
Q1306
Q1303
Q1305
Q1307
U1301
2.5V
A1
A2
2.5V
OSC
COMPARATOR
PULSE STEERING
SWITCHING REG. CONTROL
FREQ. ADJ.
25KHz P.W.M. INVERTER
+9V
U1
REGULATOR SENSOR
VOLT. ADJ.
Q1
T1
RECTIFIER
+12V
U2
ONE-SHOT MULTI
U2
ONE-SHOT MULTI
Q2,Q4
Q3,Q5
25KHz INVERTER

Fig.1-1 Power Supply Circuit Block Diagram

25kHz PWM Inverter

The 25kHz PWM inverter consists of switching regulator control IC U1301, 9V regulator Q1301/U1302, pulse width control circuit U1/Q1, driver Q1302/Q1303 and output amplifier Q1304 thru Q1307.

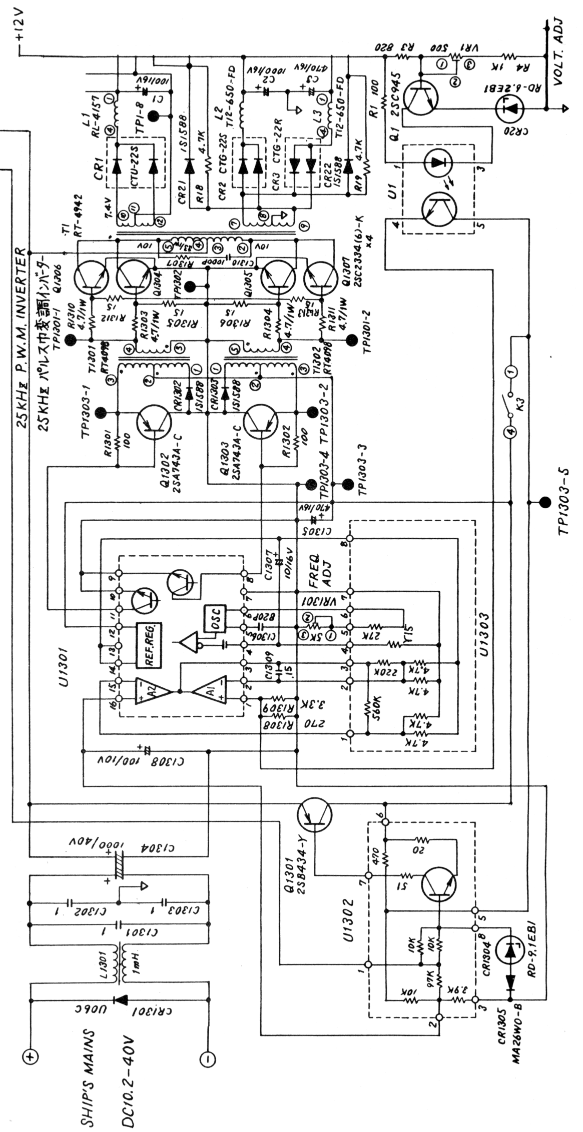

SHIP'S MAINS
DC10.2-40V
CR1301
U06C
L1301
1mH
C1301 1
C1302 1
C1303 1
C1304 1000/40V
C1308 100/10V
25KHz P.W.M. INVERTER
25KHz パルス巾変調インバーター
U1301
A1
A2
REF.REG.
OSC
R1308 270
R1309 3.3K
C1309 .15
C1306 820P
5K
VR1301
FREQ ADJ
C1307 10/16V
C1305 470/16V
Q1301
2SB434-Y
U1302
470
10K
97K
2.9K
51
20
CR1304
RD-9.1EB1
CR1305
MA26W0-B
U1303
560K
4.7K
220K
27K
Y15
TP1303-1
TP1303-2
TP1303-3
TP1303-4
TP1303-5
R1301 100
R1302 100
Q1302
2SA743A-C
Q1303
2SA743A-C
CR1302
CR1303
1S1588
T1301
T1302
RT4098
TP1301-1
TP1301-2
R1310 4.7/1W
R1311 4.7/1W
R1303 4.7/1W
R1304 4.7/1W
R1312 1.5
R1313 1.5
R1305 15
R1306 15
TP1302
R1307
C1310 1000P
10V
Q1304
Q1305
Q1306
Q1307
2SC2334(6)-K ×4
T1
RT-4942
7.4V
CR1
CTU-22S
L1
RL-4157
TP1-8
C1 1000/16V
CR21 1S1588
R18 4.7K
CR2 CTG-22S
CR3 CTG-22R
L2
T12-650-FD
L3
T12-650-FD
C2 1000/16V
C3 470/16V
CR22 1S1588
R19 4.7K
R1 100
+12V
U1
Q1 2SC945
R3 820
VR1 500
R4 1K
CR20
RD-6.2EB1
VOLT. ADJ
K3

Fig.1-2 25kHz PWM Inverter

Fig.1-3 shows the block diagram of switching regulator control IC U1301 and Fig.1-4, its operating waveform.

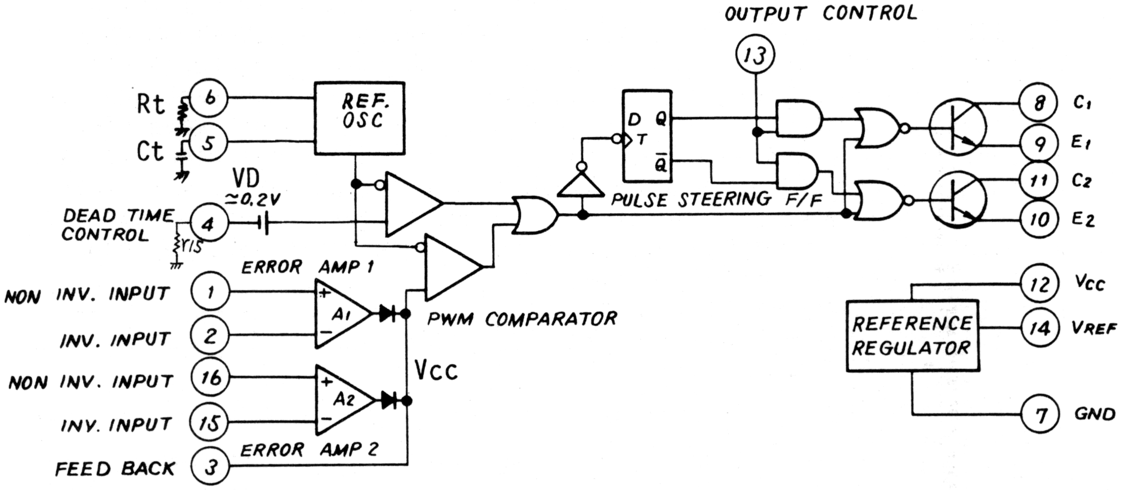
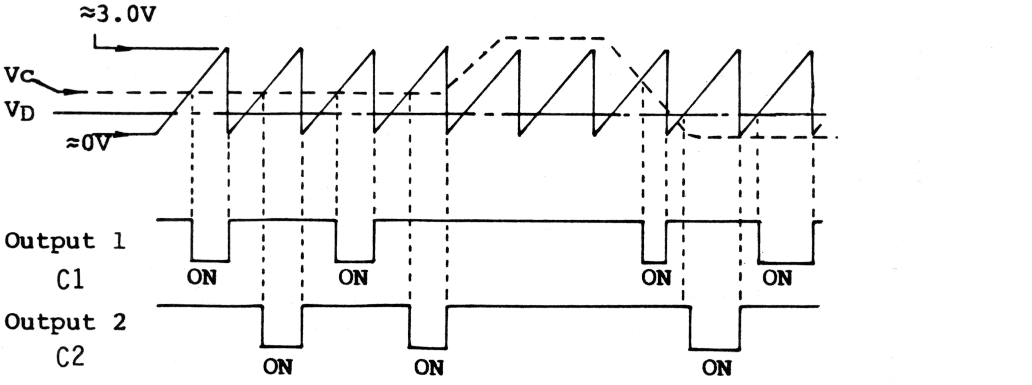

OUTPUT CONTROL
13
Rt
6
Ct
5
REF. OSC
VD
≃0.2V
DEAD TIME CONTROL
4
r15
D
T
Q
$\bar{Q}$
PULSE STEERING F/F
ERROR AMP 1
NON INV. INPUT
1
INV. INPUT
2
A1
PWM COMPARATOR
NON INV. INPUT
16
INV. INPUT
15
A2
Vcc
FEED BACK
3
ERROR AMP 2
8
C1
9
E1
11
C2
10
E2
12
Vcc
REFERENCE REGULATOR
14
VREF
7
GND

Fig.1-3 Block Diagram of Switching Regulator Control IC U1301



Vc: Output of Error Amplifier V_D: Voltage on Dead Time Control Pin

Fig.1-4 Operating Waveform of Switching Regulator Control IC

The reference oscillator in U1301 is a sawtooth wave oscillator. Its frequency is set by external resistor Rt and capacitor Ct and given by f = 1.2/CtRt. In this radar, it is set to exactly 50kHz by VR1301. The dead time control pin #4 determines a maximum duty ratio of inverter output square wave. In the switching regulator circuit, the dc output line voltages are maintained constant against fluctuation of supply voltage by varying width of output waveform. However, in case the output stage is in push-pull connection, it is necessary to limit the maximum width of the output waveform so that the width may not become so wide as to drive four output transistors into conduction simultaneously. If the ship's mains voltage drops and the duty ratio of the square wave becomes nearly 50% as in Fig.1-5, the output transistors will conduct simultaneously for a certain period because the transistors have a storage time. In the circuit shown in Fig.1-2, dead time of approximately 2us, which is longer than the storage time of the transistor 1.5us, is provided by pin #4 grounded thru r15 in U1303.

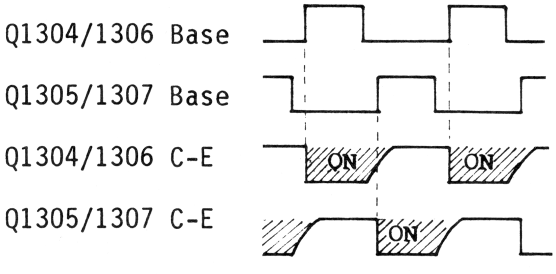

Q1304/1306 Base
Q1305/1307 Base
Q1304/1306 C-E
ON
ON
Q1305/1307 C-E
ON

Fig.1-5

C1307 and r15 in U1303 are for starting the 25kHz PWM inverter softly. The dead time control pin #4 of U1301 is fed with time varying positive voltage for about 0.1 seconds after power-on until C1307 is fully charged.

Of the two error amplifiers A1 and A2 in U1301, A1 is used to control pulse width and A2 as a comparator.

The pulse width control circuit shown in Fig.1-6 stabilizes dc output line voltages by moving up and down the slice level for the reference oscillator output sawtooth wave, that is, by converting mains and load variations into the variation of pulse width.

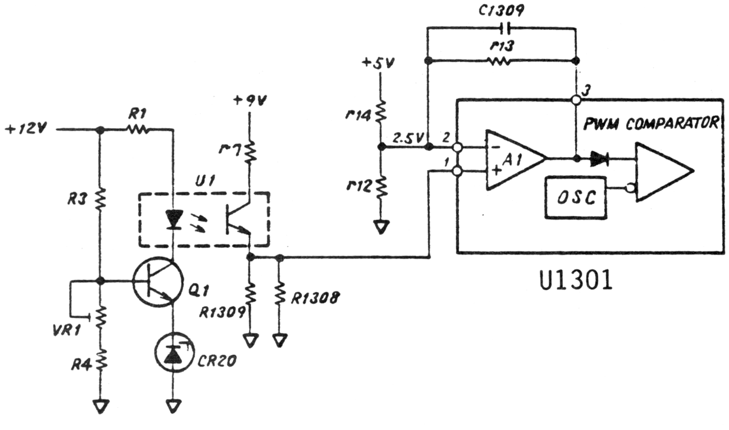

C1309
r13
+5V
r14
2.5V
2
3
1
r12
A1
PWM COMPARATOR
OSC
U1301
+12V
R1
+9V
r7
U1
R3
Q1
R1309
R1308
VR1
R4
CR20

Fig.1-6 Pulse Width Control Circuit

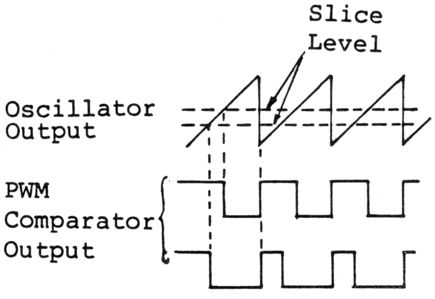

Slice Level
Oscillator Output
PWM Comparator Output

Fig.1-7

The voltage variation on +12V line is detected and fed back to the error amplifier A1 in U1301 via a photo coupler.

The error amplifier A1 has a gain of about 40dB as given by the ratio of r13 to r12/r14 and it is provided with a reference voltage of 2.5V at its inverting input pin. +12V line has been set to 11.6V with VR1 and light emitting diode in U1 is drawing current of about 20mA.
If voltage on +12V line changes by some reason, the current in the light emitting diode and then the voltage on non-inverting input pin of error amplifier changes accordingly. The difference of voltage on inverting and non-inverting pins of A1 is amplified 100 times (40dB) and the resultant dc output is fed to the PWM comparator in U1301 to move slice level of sawtooth wave as in Fig.1-7.

The regulated +9V used in the 25kHz PWM inverter is provided by the circuit shown in Fig.1-8. CR1305 is for temperature compensation. It has a temperature coefficient of about -4mV/°C against 4.6mV/°C of zener diode CR1304.

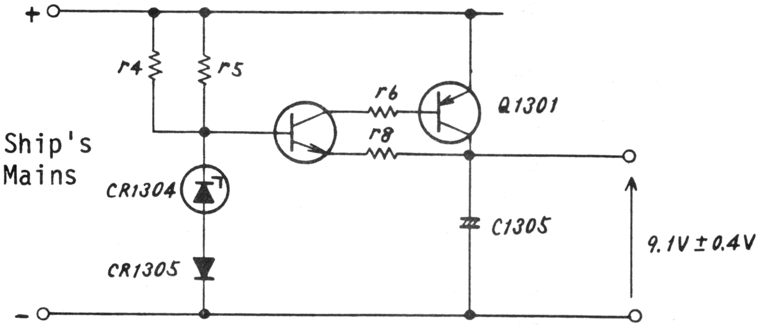

+
-
Ship's Mains
r4
r5
r6
r8
Q1301
CR1304
CR1305
C1305
9.1V ± 0.4V

Fig.1-8 +9V Regulator

25kHz Inverter

Driven by the output of the 25kHz PWM inverter, the 25kHz inverter generates +300V for the transmitter, +145V, +40V and +14V for sweep and +5V for ICs.

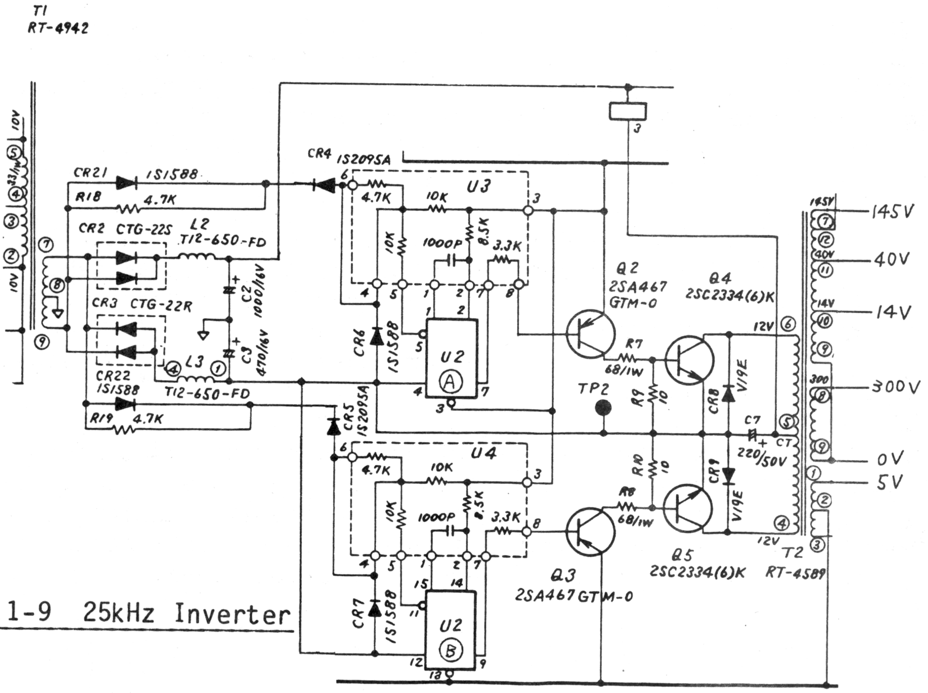

T1
RT-4942
10V
10V
CR21 1S1588
R18 4.7K
CR2 CTG-22S
L2 T12-650-FD
C2 1000/16V
CR3 CTG-22R
C3 470/16V
L3
CR22 1S1588
T12-650-FD
R19 4.7K
CR4 1S2095A
U3
4.7K
10K
10K
1000P
8.5K
3.3K
CR6 1S1588
U2 Ⓐ
CR5 1S2095A
U4
4.7K
10K
10K
1000P
8.5K
3.3K
CR7 1S1588
U2 Ⓑ
Q2 2SA467 GTM-0
Q4 2SC2334(6)K
R7 68/1W
TP2
R9 10
CR8 V19E
C7 220/50V
R10 10
R8 68/1W
CR9 V19E
Q3 2SA467 GTM-0
Q5 2SC2334(6)K
T2 RT-4589
145V
40V
14V
300V
0V
5V
12V

Fig.1-9 25kHz Inverter

Output pulselength of one-shot multivibrators U2(A) and U2(B) is 12us. U2(A) is triggered when tap #9 of power transformer T1 goes negative and U2(B), when tap #7 goes negative. Output pulses of U2(A) and U2(B) are out of phase by 180° each other. They are amplified in Q2 and Q3, and then drive output transistors Q4 and Q5 into push-pull operation.

Protector

The protector circuit shown in Fig.1-10 operates to disable the inverter operation when the following states occur.

(1) When the ship's mains exceeds 45V (mains overvoltage protection).

(2) When one of dc output lines is grounded (output shortcircuit protection).

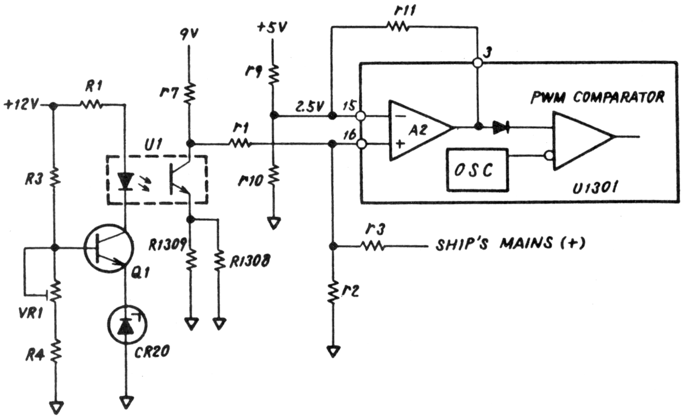


Fig.1-10 Protector

The ship's mains voltage is divided by r3 and r2, and fed to the error amplifier A2 in U1301. Value of r2 and r3 is determined so that the voltage at non-inverting pin of A2 does not exceed 2.5V as far as the ship's mains is below 45V. Then, the output of A2 usually remains negative and exerts no effect on the PWM comparator in U1301.

If the ship's mains rises to 45V, the voltage at the non-inverting pin becomes higher than 2.5V and the output of A2 goes positive. Since the positive voltage is higher than amplitude of the sawtooth wave in the output of reference oscillator, output of the PWM comparator is held "L" at all times and the sawtooth wave is blocked to suspend operation of the inverter.

The protection against shortcircuit of dc output lines is performed by Q1 and U1. If one of the dc output lines is grounded, the voltage on +12V line drops and the current flowing in the light emitting diode of U1 decreases. This results in increase in collector voltage of the photo-transistor over 2.5V, and inverter operation stops.

1-2. Timebase Circuit

The timebase is the principal part of the radar on which basic operation of the radar depends. The transmitter in the scanner unit and the sweep circuit in the display unit are put into synchronization by the control signals - trigger pulse and sweep gate pulse - generated in this circuit at a recurrence rate of 3372 pps on short range and 843 pps on long range. Further, the timebase circuit determines sweep period on each range, generates range ring pulses and holds down the radar operation for 2'45" at initial power-on for warming-up. The range ring intervals on each range are shown in Table 1-1 and the block diagram of the timebase in Fig.1-11.

Table 1-1

Range (n.m.)	Range Ring Interval (n.m.)	Pulse Repetition Rate (pps)
1/4	1/8	3372
1/2	1/8	3372
1 1/2	1/4	3372
3	1/2	843
6	1	843
12	2	843
24	4	843
36 (*)	6	843

(*): FR-360 MARK-II only

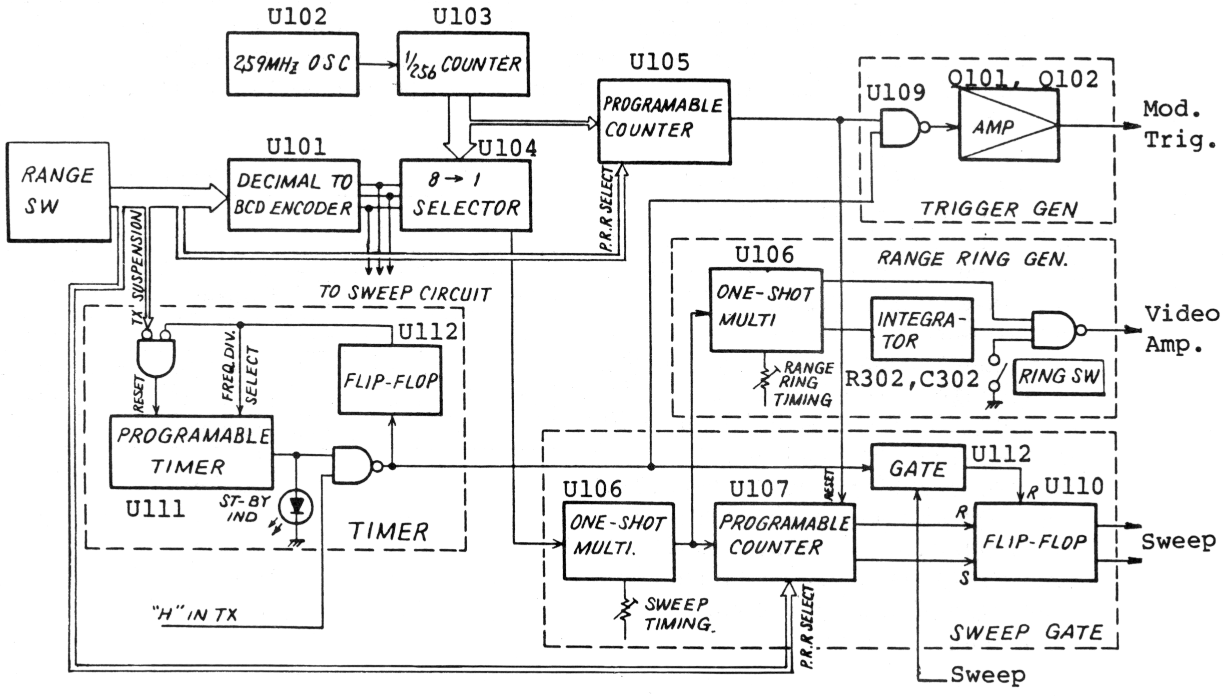

U102
2.59MHz OSC
U103
1/256 COUNTER
U105
PROGRAMABLE COUNTER
U101
DECIMAL TO BCD ENCODER
U104
8 → 1 SELECTOR
RANGE SW
TX SUSPENSION
P.R.R SELECT
TO SWEEP CIRCUIT
U109
Q101, Q102
AMP
TRIGGER GEN
Mod. Trig.
U106
ONE-SHOT MULTI
RANGE RING GEN.
INTEGRATOR
RANGE RING TIMING
R302,C302
RING SW
Video Amp.
U112
FLIP-FLOP
RESET
FREQ.DIV. SELECT
PROGRAMABLE TIMER
U111
ST-BY IND
TIMER
"H" IN TX
U106
ONE-SHOT MULTI.
SWEEP TIMING
U107
PROGRAMABLE COUNTER
RESET
GATE
U112
U110
R
S
FLIP-FLOP
Sweep
SWEEP GATE
P.R.R SELECT
Sweep

Fig.1-11 Timebase Block Diagram

Pulse Repetition Rate and Trigger Pulse Gen.

Pulse repetition rates of 3372 pps on short range and 843 pps on long range are determined by the circuit shown in Fig.1-12.

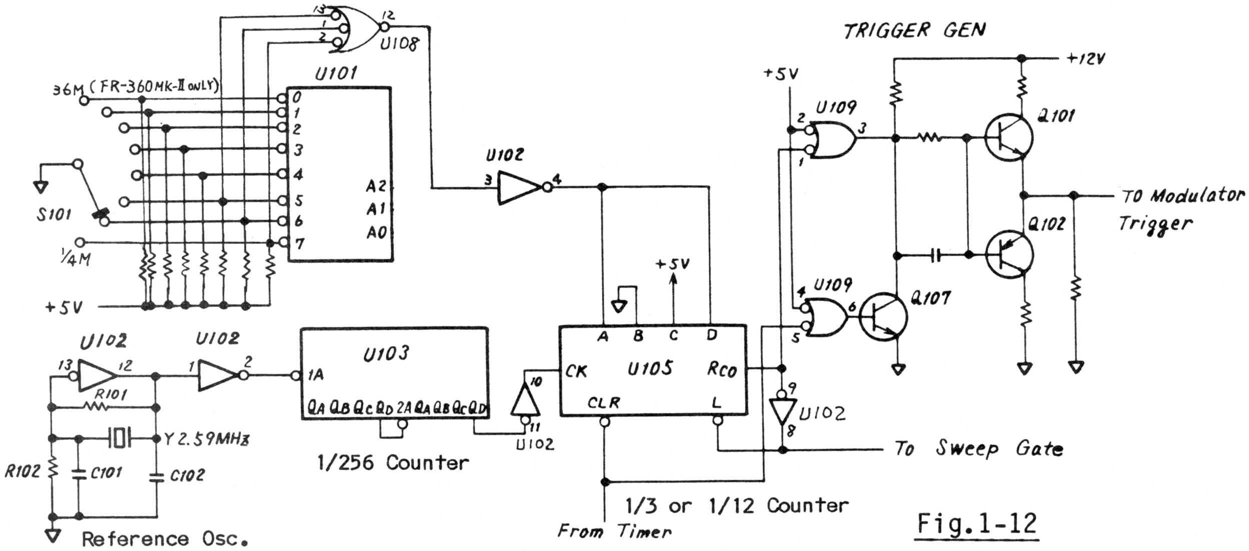

U108
U101
36M (FR-360MK-II ONLY)
0
1
2
3
4
5
6
7
A2
A1
A0
S101
1/4M
+5V
U102
TRIGGER GEN
+5V
+12V
U109
Q101
TO Modulator Trigger
Q102
U109
Q107
+5V
A B C D
CK U105 RCO
CLR L
U102
To Sweep Gate
U102
U102
R101
Y 2.59MHz
R102
C101
C102
Reference Osc.
U103
1A
QA QB QC QD 2A QA QB QC QD
1/256 Counter
U102
1/3 or 1/12 Counter
From Timer

Fig.1-12

U103 is 1/256 counter and U105 is a programable counter that operates as 1/3 counter in short range and 1/12 counter in long range. 2.59MHz signal from the reference oscillator is divided down to 10117Hz by U103 and further down to 3372Hz in short range and 843Hz in long range by U105.

Table 1-2 U105 Truth Table

Input					Output		
Clear	Load	CK	Enable P	Enable T	$Q_AQ_BQ_CQ_D$	Ripple Carry	Operation
H	H	⎍	H	H	-	-	Count
H	L		X	X	$D_AD_BD_CD_D$	-	Data Set
L	X	X	X	X	L L L L	-	Clear
H	X	X	X	H	H H H H	⎍	-

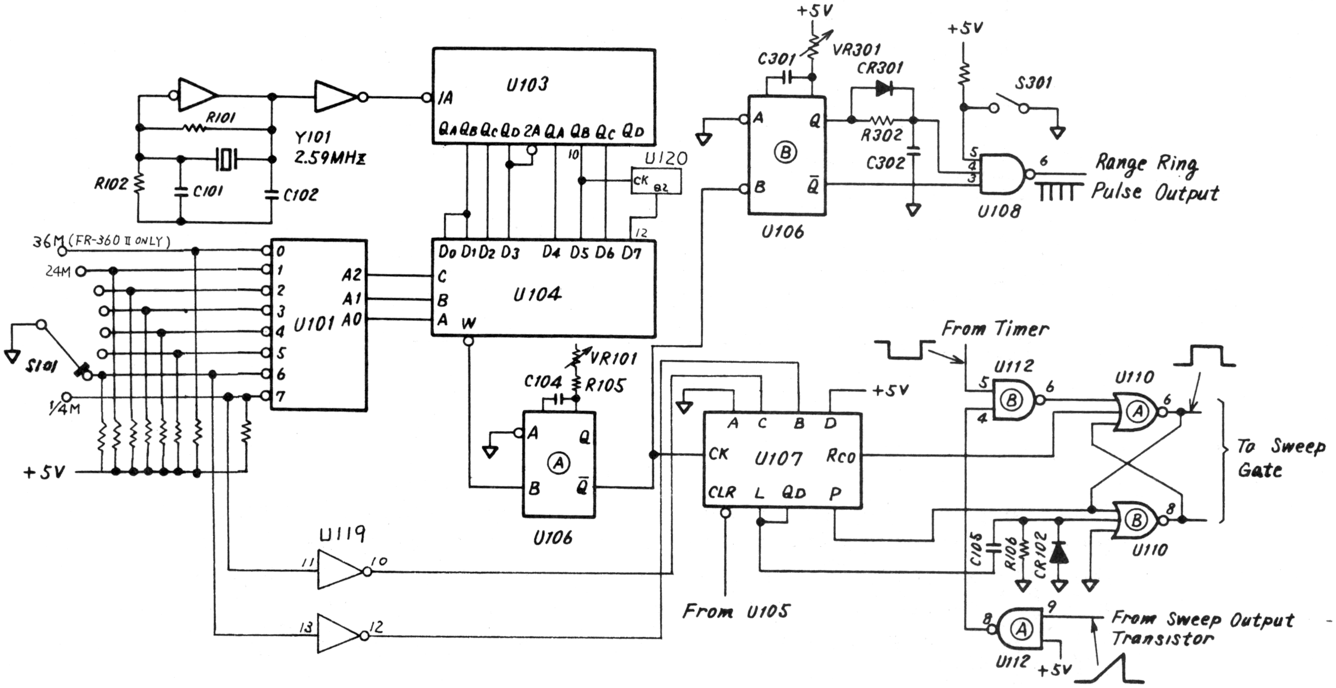
Programing of counting scale in U105 is done at its pins "A", "B", "C" and "D" by RANGE switch S101 connected via U108 and U102. "B" and "C" are preset to low and high respectively. When short range (or long range) is selected, the preset pins "A" and "D" of U105 via U108 and U102 become high (or low) level. Therefore U105 gives an output at count 13 (or 4) in short range (or long range). This results that U105 operates as 1/3 counter in short range and 1/12 counter in long range.

The CLR pin of U105 is connected to the timer circuit and goes "L" to disable U105 for 2 minutes 45 seconds warming-up period at initial power-on. It also goes "L" when the FUNCTION switch is set at "ST-BY".

The trigger pulse generator comprises U109, Q101, Q102 and Q107. It reshapes and amplifies U105 output to a level between 6.8V and 8.7V, and sends it to the modulator trigger generator in the scanner unit.

Sweep Gate and Range Ring Gen.

The sweep gate circuit produces a pulse of which pulselength determines the sweep period on each range, and sends it to the sweep circuit.



+5V
C301
VR301
CR301
R302
C302
S301
U103
1A
QA QB QC QD 2A QA QB QC QD
10
U120
CK
12
R101
R102
Y101
2.59MHz
C101
C102
36M (FR-360 II ONLY)
24M
1/4M
S101
+5V
U101
A2
A1
A0
D0 D1 D2 D3 D4 D5 D6 D7
C
B
A
W
U104
U106
A
B
Q
Range Ring Pulse Output
U108
VR101
C104
R105
U106
From Timer
U112
U110
To Sweep Gate
CK
CLR
U107
RCO
A C B D
L QD P
U119
From U105
C105
R106
CR102
From Sweep Output Transistor

Fig.1-13 Sweep Gate and Range Ring Gen.

U101 is a decimal to BCD encoder. Depending on the logic status on input pins 0 thru 7, it outputs a BCD number to the output pins A0, A1 and A2 as shown in Table 1-3.

Table 1-3 U101 Truth Table

Input								Output		
0	1	2	3	4	5	6	7	A2	A1	A0
L	H	H	H	H	H	H	H	H	H	H
X	L	H	H	H	H	H	H	H	H	L
X	X	L	H	H	H	H	H	H	L	H
X	X	X	L	H	H	H	H	H	L	L
X	X	X	X	L	H	H	H	L	H	H
X	X	X	X	X	L	H	H	L	H	L
X	X	X	X	X	X	L	H	L	L	H
X	X	X	X	X	X	X	L	L	L	L

* X: Either "H" or "L"

Output at respective stages of counter U103 are fed to data selector U104 and one of them (D0 thru D7 input signals) is taken out from the output pin "W" according to the RANGE switch setting with its phase inverted. On the other hand, flip-flop U120 divides the signal at pin "QB" of U103 into one third, and this signal is fed to D7 of U104. For example, in 1/4 mile range, the input signal on D0 comes out from pin "W" as a $\overline{D0}$ output signal. See Tables 1-3 and 1-4.

Table 1-4 U104 Truth Table

INPUT				OUTPUT	
SELECT			STROBE	Y	W
C	B	A	S		
×	×	×	H	L	H
L	L	L	L	D_0	$\overline{D}_0$
L	L	H	L	D_1	$\overline{D}_1$
L	H	L	L	D_2	$\overline{D}_2$
L	H	H	L	D_3	$\overline{D}_3$
H	L	L	L	D_4	$\overline{D}_4$
H	L	H	L	D_5	$\overline{D}_5$
H	H	L	L	D_6	$\overline{D}_6$
H	H	H	L	D_7	$\overline{D}_7$

X: Either "H" or "L".

U106 is a one-shot multivibrator for sweep timing adjustment. It compensates for propagation time in the cable between the display unit and the scanner unit. It is adjusted at installation with VR101 depending on cable length so that the sweep on the screen starts at the moment the leading edge of the transmission leakage signal arrives at the CRT cathode.

Programable 4 bit counter U107 and R-S flip-flop consisting of 2 gates U110A and U110B operate as follows to determine the sweep period.

1. U107 is enabled when its CLR terminal is set "H" by U105 output signal. See Fig.1-14.

2. U107 is preset to count 12 (10 or 8) in ¼ range (½ or other) on terminals "A", "B", "C" and "D" because programing of counting scale of U107 depends on the status "B" and "C" of U107 connected to range switch via U119.

   Example: In ¼ mile range, terminals "A", "B", "C" and "D" are set at "L", "L", "H" and "H" respectively , i.e., preset to count 12.

   1) When first positive going edge of U106A output signal is applied to the CK terminal of U107, its QD output becomes from "L" to "H". See Fig.1-14.

   2) The "H" output at QD is, after differentiated by C105 and R106, applied to the R-S flip-flop and sets U110A output to "H" and U110B output to "L". See Fig.1-14.

   3) In succession, U107 counts 3 input signals and stops at fourth input signals with its carry output pin Rco gone "H". The "H" output at Rco drives the R-S flip-flop into the opposite state.

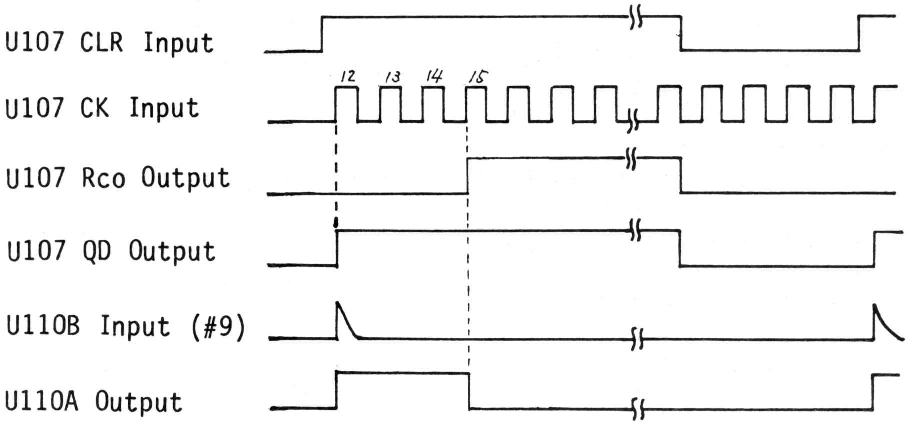


Fig.1-14 Sweep Gate Waveform Chart in ¼ Mile Range

4) U107 is cleared and disabled when U105 output signal goes "L".

5) The sweep period equivalent to 3 wavelengths of U104 "W" output signal is provided on U110A and U110B outputs.

The rectangular wave signal fed to the R-S flip-flop thru U112B disables the sweep circuit by driving U110A output to "L" and U110B output to "H" for 2 minutes 45 seconds after power-on and also for 0.6 seconds when the range scale is changed between 1 ½ n.m. (short range) and 3 n.m. (long range). The signal coming to the R-S flip-flop via two gates U112A and B from the sweep circuit is to protect the sweep circuit output stage. When an abnormal current flows into the deflection coil by some reason, it stops the sweep circuit operation immediately by driving U110A output to "L". While the sweep circuit output stage is normal, peak current of approximately 2.6A to 3.4A flows into the deflection coil. The circuit is designed to change-over the R-S flip-flop when the peak current reaches to an abnormal level of approximately 3.5A.

The range ring generator made up of U106B, CR301, U108 and associated components receives, from sweep timing adjustment one-shot multivibrator U106A, square wave signal whose wavelength is equivalent to range ring interval and integrates it to produce range ring pulses.

U106B adjusts the timing between the range ring and the sweep. Compensating for delay of range ring pulses in the coupling diode and and the video amplifier, it is adjusted with VR301 so that the first range ring pulse may coincide with the sweep start on the CRT.

The Q output of U106B charges C302 via CR301 while its level is "H" and discharges C302 thru R302 when the level is "L". Respective range ring pulses are generated at U108 output, having a pulse length starting at the moment Q of U106B goes "L" and terminating at the moment the voltage across C302 drops below input threshold of U108. See Fig.1-15. The theoretical pulselength td is about 130 ns as calculated from the following formula.

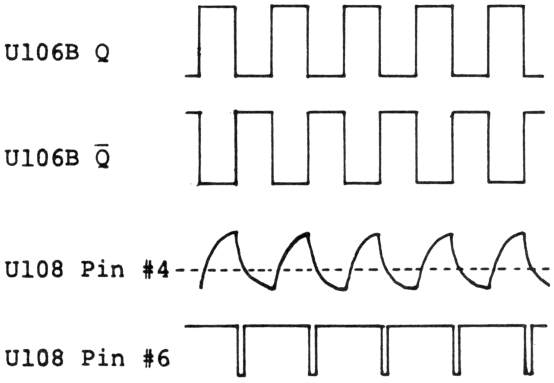


Fig.1-15 Range Ring Gen. Waveform Chart

$$td = C302 \cdot R302 \ln \frac{V_{OH}}{V_{TH}} = 9.54 \times 10^{-8} \ln \frac{4.3}{1.1} \fallingdotseq 130 \times 10^{-9} (s)$$

where V_{OH}= Logical "H" output voltage

V_{TH}= Threshold voltage

Timer

The magnetron must be pre-heated for about 3 minutes before excited by the modulator. In order to ensure this warming-up period, the timer circuit inhibits the operation of transmitter and sweep circuit for 2 minutes 45 seconds after switching on the radar. The schematic diagram is shown in Fig.1-16.

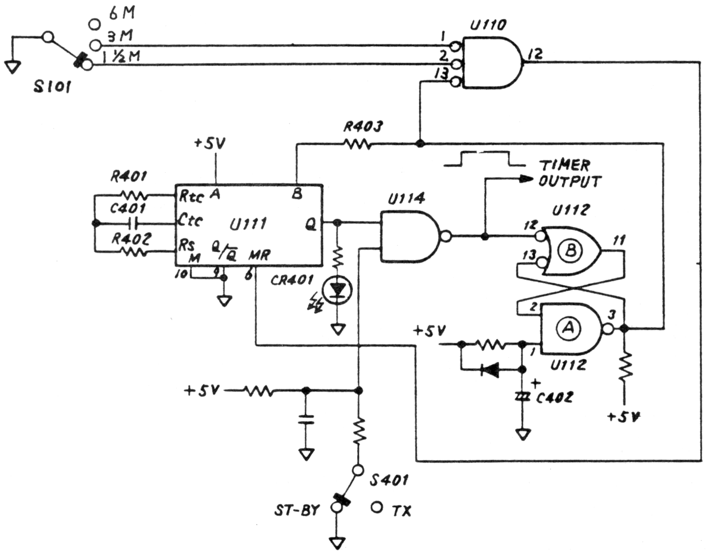


Fig.1-16 Timer

Table 1-5 U111 Truth Table

TRUTH TABLE

Pin	State 0	State 1
5	Auto Reset Operating	Auto Reset Disabled
6	Timer Operational	Master Reset On
9	Output Initially Low After Reset	Output Initially High After Reset
10	Single Cycle Mode	Recycle Mode

FREQUENCY SELECTION TABLE

A	B	Number of Counter Stages n	Count 2^n
0	0	13	8192
0	1	10	1024
1	0	8	256
1	1	16	65536

U111 is a programable timer incorporating an oscillator and a 16 stage binary counter, where the counter scale can be controlled as in Table 1-5 depending on logic status on pins "A" and "B". In the circuit of Fig.1-16, both pins "A" and "B" are held "H" after the radar is switched on to use all 16 stages. Fig.1-17 shows the block diagram of U111.

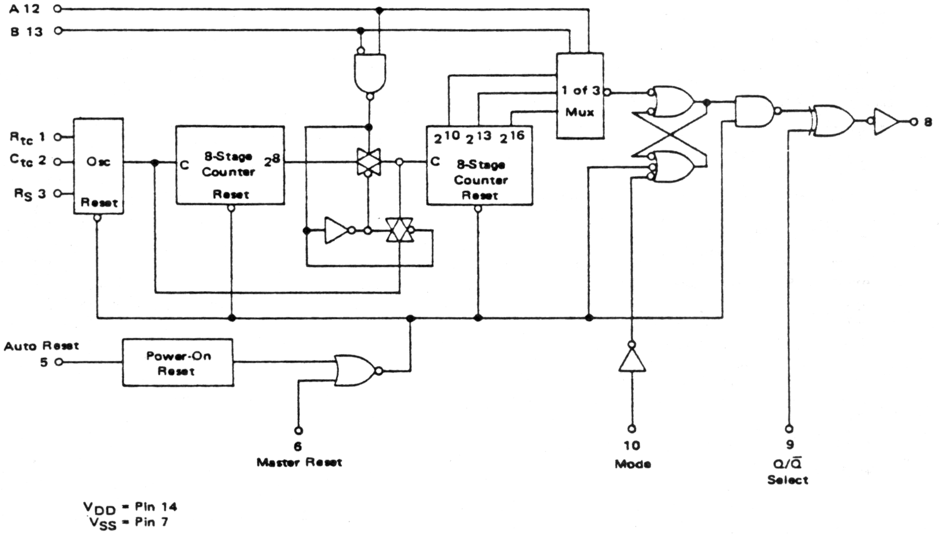

A 12
B 13
R_{tc} 1
C_{tc} 2
R_S 3
Osc
Reset
C
8-Stage Counter
2^8
Reset
2^{10} 2^{13} 2^{16}
C
8-Stage Counter
Reset
1 of 3 Mux
8
Auto Reset
5
Power-On Reset
6
Master Reset
10
Mode
9
Q/$\bar{Q}$ Select
V_{DD} = Pin 14
V_{SS} = Pin 7

Fig.1-17 Block Diagram of U111

The output Q of U111 goes "H" when the last counter of the 16 stages changes its state, that is, when the 16 stage counter is fed with 32768 pulses (a half of 65536 in Table 1-5) from the oscillator. Since the radar is considered the required warming-up time has elapsed when the Q terminal goes "H", the oscillator frequency should be set to f = 32768/165 = 199Hz to obtain the 2 minutes 45 seconds (165 seconds) warming-up, thus, the frequency is set to 199Hz by external CR network connected to Rtc and Ctc terminals as given by f = 1/2.3xR401xC401. In addition, since the mode pin "M" is grounded, U111 operates on single cycle mode. Once an output is sent out, the internal R-S flip-flop is locked and no further change occurs.

With the Q of U111 goes "H", if the FUNCTION switch S401 is moved from "ST-BY" to "TX", output of U114 goes "L" and the R-S flip-flop consisting of U112A and U112B is set to "H" in U112B output and "L" in U112A output.

Transmission Suspension

When the range scale is changed from long range to short range or vice versa, the relay in the modulator trips to change the transmission pulselength, and hence the transmission should be suspended for a while (0.6 seconds) to allow for the relay to complete its movement.
This is done as follows.

Since RANGE switch S101 is make-before-break type, its 1 1/2 and 3 n.m. terminals are grounded simultaneously for a moment when it is switched between them. This results in U110 output going "H" and U111 being reset with its Q output turned to "L". Once U111 is reset, it again becomes operational but since its pin "B" is "L" now, only 8 stages out of 16 stages are used. This holds the Q output "L" for 0.6 seconds.

1-3. Sweep Circuit

The sweep circuit is made up of a trapezoid wave generator, deflection circuit and an unblanking pulse generator. The purpose of this circuit is to draw a sawtooth current into the deflection coil.

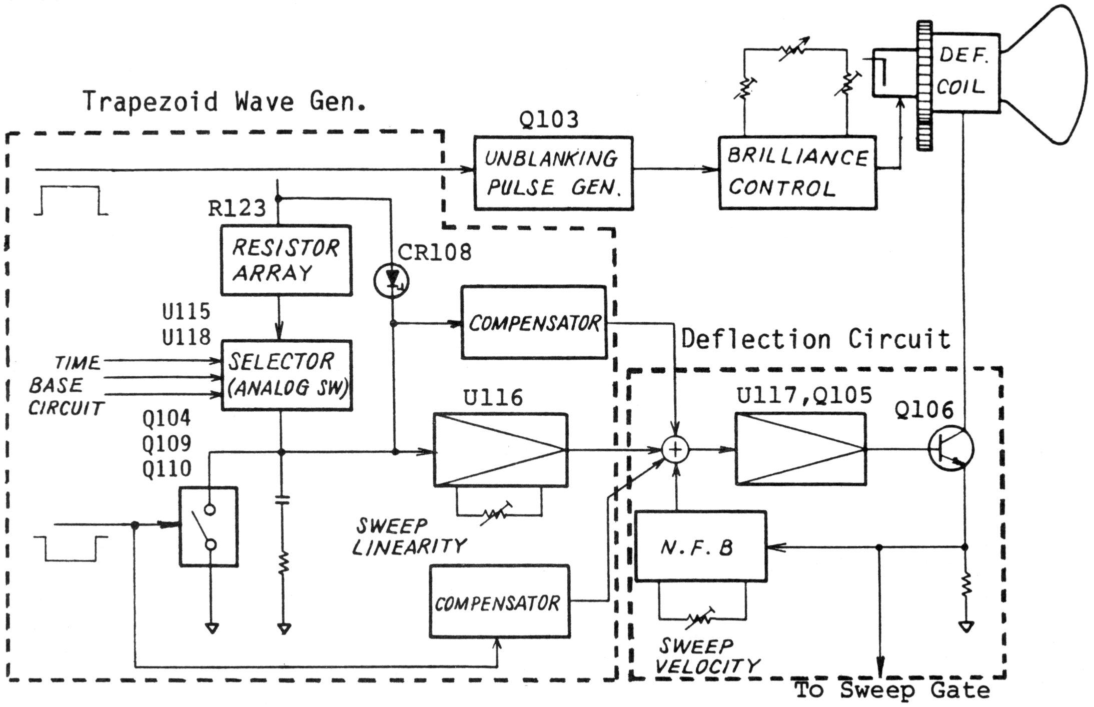

Trapezoid Wave Gen.
Q103
UNBLANKING PULSE GEN.
BRILLIANCE CONTROL
DEF. COIL
R123
RESISTOR ARRAY
CR108
COMPENSATOR
U115
U118
TIME BASE CIRCUIT
SELECTOR (ANALOG SW)
Deflection Circuit
U116
U117,Q105
Q106
Q104
Q109
Q110
SWEEP LINEARITY
N.F.B
COMPENSATOR
SWEEP VELOCITY
To Sweep Gate

Fig.1-18 Sweep Circuit

Trapezoid Wave Generator

The schematic diagram of the trapezoid wave generator is shown in Fig.1-19.

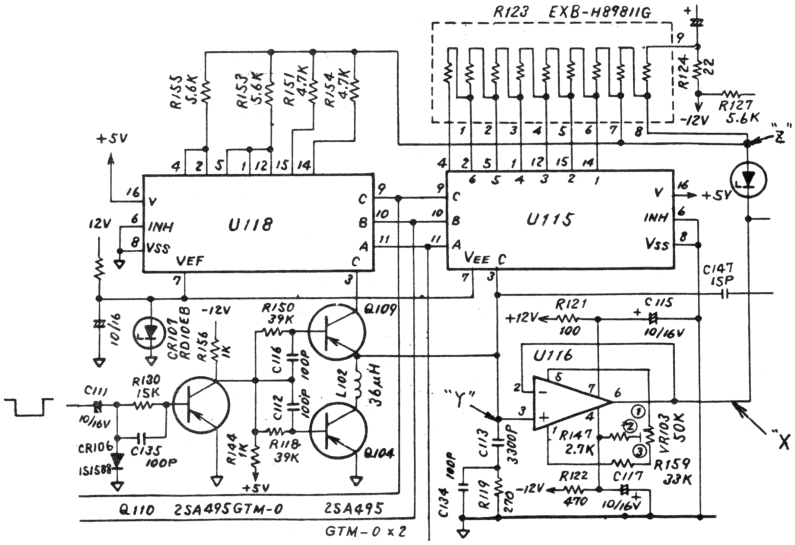

R123 EXB-H898I1G
R155 5.6K
R153 5.6K
R151 4.7K
R154 4.7K
R124 22
R127 5.6K
-12V
"Z"
+5V
12V
U118
U115
V
INH
VSS
VEF
C
B
A
VEE
+5V
C147 15P
C115 10/16V
R121 100
+12V
CR107 RD10EB
-12V
R150 39K
R156 1K
Q109
C116 100P
C112 100P
L102 36μH
U116
"Y"
C111 10/16V
R130 15K
CR106 1S1588
C135 100P
R144 1K
R118 39K
Q104
C113 3300P
R147 2.7K
VR103 50K
R159 33K
R122 470
C117 10/16V
C134 100P
R119 270
-12V
"X"
Q110 2SA495GTM-0
2SA495 GTM-0 x 2

Fig.1-19 Trapezoid Wave Gen.

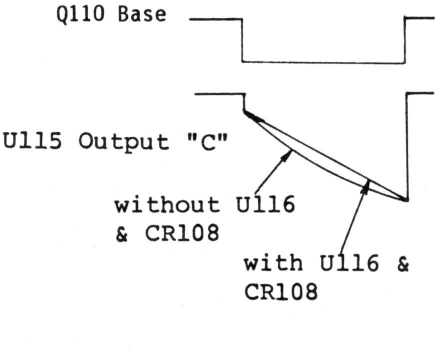

Q110 Base
U115 Output "C"
without U116 & CR108
with U116 & CR108

Fig.1-20

To make explanation simpler, first let's neglect operational amplifier U116 and zener diode CR108.

In the stable state, Q110 is cut off and Q104/Q109 are conductive. Therefore the potential at pin "C" of U115 is zero and there is no charge in C113. U115/U118 are analogue switches called multiplexer. It connects one of input pins #1 thru #7 to output pin "C" as controlled by the logic status on input pins "A", "B" and "C". See Table 1-6.

If the square wave shown in Fig.1-20 is introduced to Q110 base, Q110 goes conductive and its collector raises from -12V up to 0V. Therefore Q104/Q109 turns off and the voltage at "C" of U115 drops suddenly to a negative value depending on the RANGE switch setting. The voltage then drops further as C113 charges as in Fig.1-20, forming a trapezoidal shape. If this trapezoid wave is amplified and directly used to control the sweep current in the deflection circuit, the sweep trace becomes poor in its linearity. U116 and CR108 improve the linearity by charging C113 by a constant current as follows.

Table 1-6 U115 Truth Table

Control Inputs				Channel No. connected to "C" terminal
Inhibit	C	B	A	
L	L	L	L	0
L	L	L	H	1
L	L	H	L	2
L	L	H	H	3
L	H	L	L	4
L	H	L	H	5
L	H	H	L	6
L	H	H	H	7
H	*	*	*	None

*: Either "H" or "L"

U116 and associated components from a voltage follower. The voltage follower is an impedance translator that features unity voltage gain, high input impedance. Then, the points "X" and "Y" in Fig.1-19 are maintained always at the same potential. Besides, since CR108 is a 5V zener diode, the voltage between points "X" and "Z" is constant at 5V and therefore the voltage between "Y" and "Z" is also constant at 5V. This indicates that while the square wave of Fig.1-20 is present at Q110 base, a constant current flows from "X" to "Y" and C113 is charged at a constant speed, making the slope of the trapezoid wave at "X" and "Y" linear. The peak level of the trapezoid wave is approximately 1.8V to 2.4V.

L102 at Q104 collector is for absorbing switching noise of Q104. VR103 is for adjusting offset zero of operational amplifier U116.

Amplifier and Deflection Circuit

The signal coming from the trapezoid wave generator is amplified in the current amplifier of Fig.1-21 and draws a sawtooth current into the deflection coil connected to the collector of the output transistor Q106.

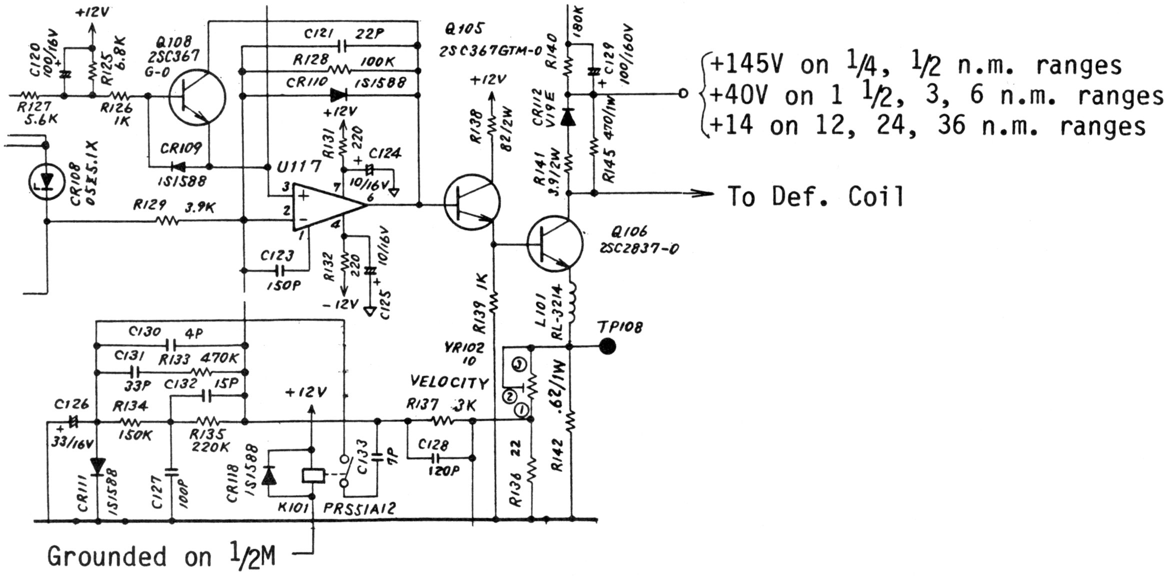

+12V
C120 100/16V
R125 6.8K
Q108 2SC367 G-O
R127 5.6K
R126 1K
CR109 1S1588
CR108 05Z5.1X
R129 3.9K
C121 22P
R128 100K
CR110 1S1588
+12V
R131 220
C124 10/16V
U117
C123 150P
R132 220
C125 10/16V
-12V
Q105 2SC367GTM-O
+12V
R138 82/2W
R140 180K
CR112 V19E
C129 100/160V
R141 3.9/2W
R145 470/1W
+145V on 1/4, 1/2 n.m. ranges
+40V on 1 1/2, 3, 6 n.m. ranges
+14 on 12, 24, 36 n.m. ranges
To Def. Coil
Q106 2SC2837-O
R139 1K
L101 RL-3214
TP108
VR102 10
VELOCITY
R137 3K
C128 120P
R136 22
R142 .62/1W
C130 4P
C131 33P
R133 470K
C132 15P
+12V
C126 33/16V
R134 150K
R135 220K
CR111 1S1588
C127 100P
CR118 1S1588
K101 PRSS1A12
C133 7P
Grounded on 1/2M

Fig.1-21 Amplifier/Deflection Circuits

U117 is an inverting amplifier with a gain of about 36dB, Q105 is an emitter follower for impedance translation, Q106 is a power amplifier, and these three stages form a feedback amplifier. The total gain of the amplifier is given by the ratio of feedback resistor to the input resistor, i.e., ratio of R136/R137/VR102 to R129. Usually it is adjusted with VR102 so that peak current of 2.6A to 3.4A may flow through deflection coil L181, that is, so that a sawtooth voltage of 1.6V to 2.1V may develop across R142 (0.62 ohms). In practice, it is adjusted by observing the screen so that the outermost range ring locates just inside the screen edge.

C147 sharpens the leading edge of the trapezoid wave, compensating for deterioration caused by slew rate of the operational amplifier.
The network consisting of C130, C131, R133, R134, C132 and R135 moderates the leading edge of trapezoid wave in short range (Specially in 1/4 mile range, C133 is put in parallel with C130 to moderate further the leading edge by making K101 active.) since above compensation is excessive and it also adds a square wave to the trapezoid wave.
In short, it is said that the sawtooth portion of the trapezoid wave is generated by C113 and its square wave portion is set to proper level by R129 and above mentioned two compensators.

CR110 prevents U117 from latching up to -12V which reversely biases Q105 emitter and base. C121 and C123 improve frequency characteristic and C128 prevents parastic oscillation.

Q108 prevents Q105/Q106 from conducting permanently when -12V is absent from U117 by some reason. If -12V is absent from U117, U117 operates on the voltage between 0V and +12V, developing a positive voltage of 2 thru 3V at its output even under no signal condition and leading to permanent conduction of Q105/Q106. Q108 conducts with -12V absent and grounds Q105 base to prevent this.

R141 and CR112 protect Q106 by absorbing inverse voltage spike which occurs in deflection coil L181 after termination of the trapezoid wave on Q106 base. R145 is a dumper resistor. It suppresses the transient phenomena such as a parastic oscillation or nonlinear rise of sawtooth current that tends to occur on short ranges due to stray capacity around L181. L101 at the emitter of Q106 rejects spike and noise superposed on the sweep drive signal.

Unblanking Pulse Generator

Q103 and associated components form the unblanking pulse generator. It receives the positive going rectangular wave from U110 and sends out a positive going rectangular wave to the grid of CRT thru C503 in order to make the sweep on the CRT visible.

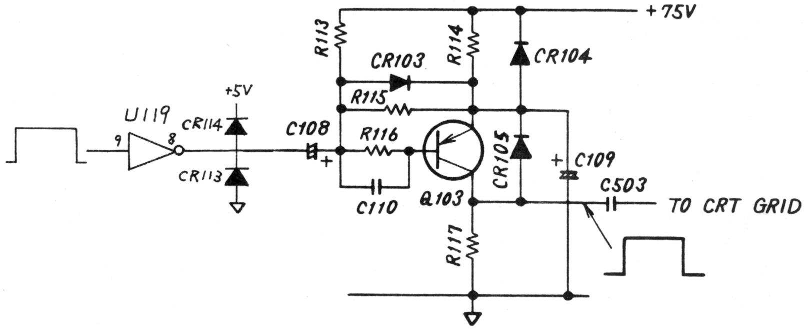


Fig.1-22 Unblanking Pulse Generator

The amplitude of the positive going rectangular wave (unblanking pulse) varies with the range setting so that higher amplitude is obtained on shorter ranges. This is accomplished by varying the emitter potential of Q103 as follows.

Since the smoothing capacitor C109 is provided between Q103 emitter and the ground, the potential on Q103 emitter is a dc voltage which is lower by R114 x (Q103 mean emitter current) than the supply voltage of +75V. Q103 emitter current in mean value is directly proportional to the input waveform, and therefore Q103 emitter potential decreases as the range setting is changed to a longer range. This reduction in the potential at Q103 emitter causes decrease of collector current and lowering of unblanking pulse amplitude.

The purpose of getting the range-varying amplitude is to regulate the CRT brightness without using specific brilliance preset on each range.

CR104 provides a discharging path for C109 when the radar is turned off. CR105 prevents the collector to emitter voltage of Q103 from exceeding the maximum rating when an impulse voltage is developed on the CRT grid.

1-4. Auto heading Alignment Circuit

The auto heading alignment circuit includes a DF coil drive circuit and an auto heading alignment circuit. Fig.1-23 shows its block diagram and Fig.1-24, schematic diagram.

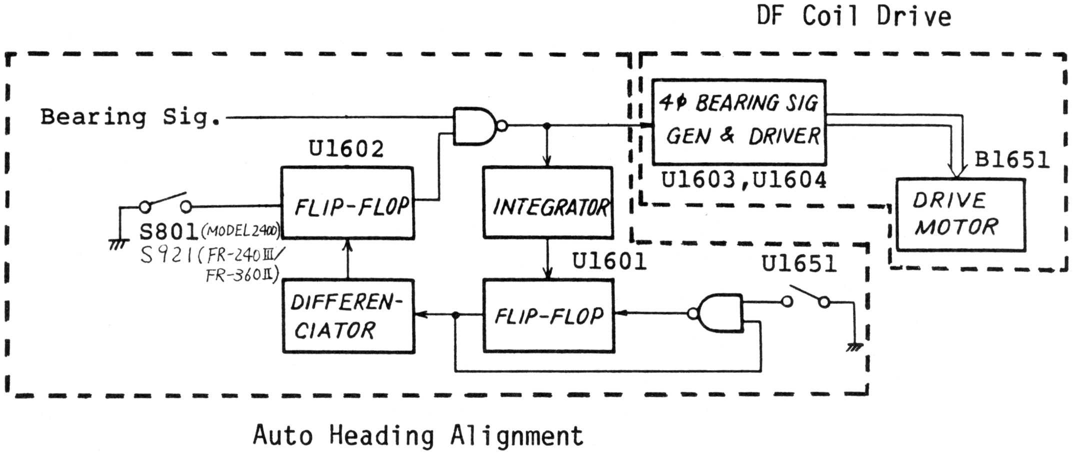

DF Coil Drive
Bearing Sig.
U1602
FLIP-FLOP
INTEGRATOR
4φ BEARING SIG GEN & DRIVER
U1603,U1604
B1651
DRIVE MOTOR
S801(MODEL 2400)
S921(FR-240III/ FR-360II)
DIFFEREN-CIATOR
U1601
FLIP-FLOP
U1651
Auto Heading Alignment

Fig.1-23 Block Diagram of Auto Heading Alignment Circuit

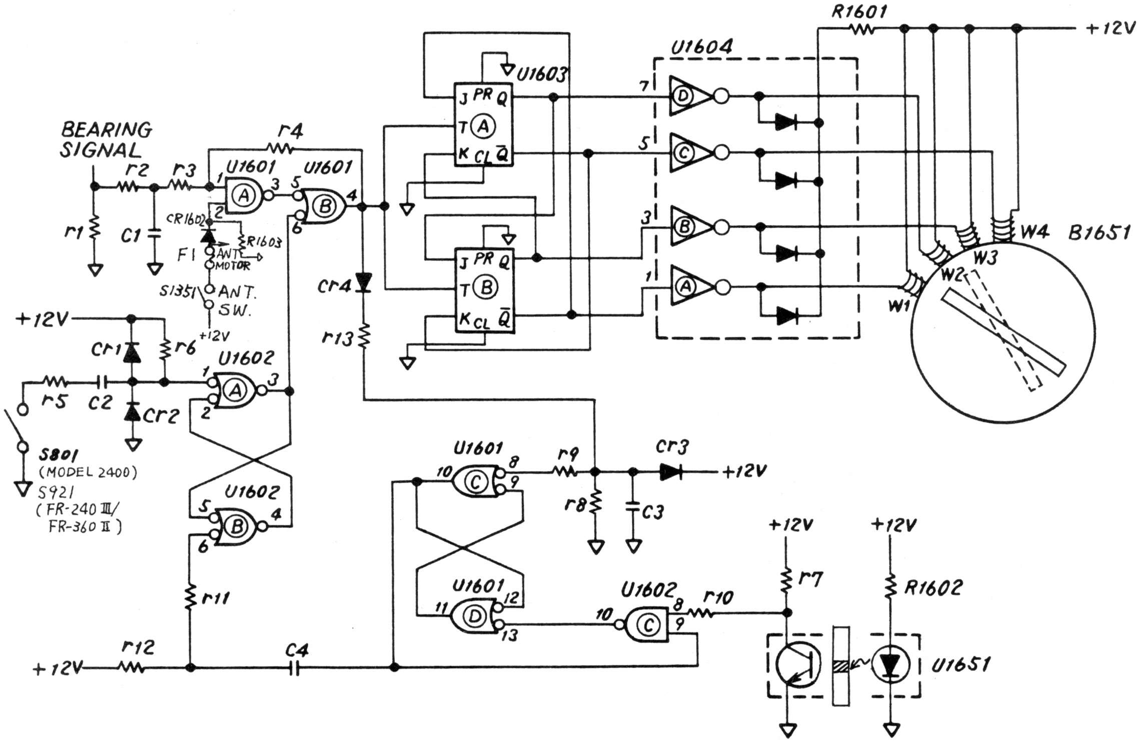

BEARING SIGNAL
r1
r2
r3
r4
C1
U1601
U1601
CR1602
R1603
F1
ANT MOTOR
S1351
ANT. SW.
+12V
Cr1
r6
U1602
r5
C2
Cr2
S801 (MODEL 2400)
S921 (FR-240III/ FR-360II)
U1602
r11
r12
+12V
C4
cr4
r13
U1603
J PR Q
T A
K CL Q̄
J PR Q
T B
K CL Q̄
U1604
D
C
B
A
R1601
+12V
W1
W2
W3
W4
B1651
U1601
r9
cr3
+12V
r8
C3
U1601
U1602
r10
+12V
+12V
r7
R1602
U1651

Fig.1-24 Auto Heading Alignment Circuit

DF Coil Drive Circuit

The deflection coil drive circuit receives the bearing signal of 180Hz from the bearing transmitter in the scanner unit and divides it down to 45Hz, 4 phase square wave by 2 J-K flip-flops, U1603 (A) and (B). Outputs of the flip-flops are fed thru U1604 to the deflection coil drive motor B1651. The motor rotates at a speed of 225rpm and drives the deflection coil thru the step-down gears (gear ratio 1:9.375) so that the deflection coil rotation is in synchronism with the antenna rotation of 24rpm. How the 45Hz, 4 phase square wave drives B1651 is described below.

Flip-flops U1603 (A) and (B) receive the bearing signal thru U1601 (A) and (B) and produces the 4 phase square wave as shown in Fig.1-25. During the period "1", the output of U1604 (A) and (D) is in "L" status. The stator field coils W1 and W2 of the deflection coil drive motor B1651 draw current from +12V line thru U1604, then the rotor comes at the center of coils W1 and W2 as shown in Fig.1-24. In the period "2", current flows to the coils W2 and W3, and the rotor steps to the center of W2 and W3 as shown by dotted line in Fig.1-24. In this manner, driven by the flip-flop output waveforms, B1651 makes a step-by-step rotation. The stator field coils are arranged around the circumference of a circle at 7.5° interval, and 48 pulses are required to make one full revolution.

Diodes in U1604 absorb the inverse electromotive force induced in the stator windings.

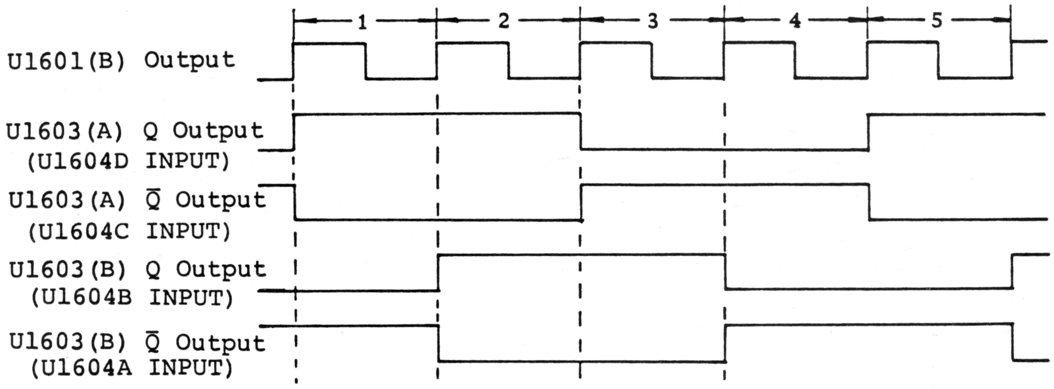


Fig.1-25

Auto Heading Alignment Circuit

The auto heading alignment circuit controls the rotation of deflection coil drive motor B1651 so that the sweep trace on the CRT points in the same direction as the antenna. The circuit consists of U1601 (C)/(D), U1602 (A)/(B)/(C) and U1651.

Let's suppose that the R-S flip-flop consisting of U1602 (A) and (B) is set at a status where U1602 (A) output is "H" and U1602 (B) output is "L". Let's suppose further that the R-S flip-flop consisting of U1601 (C) and (D) is at a status U1601 (C) output is "H" and U1601 (D) output is "L". Under these conditions, the bearing signal from the scanner unit passes U1601 (B) and drives motor B1651.

Photo interrupter U1651 is located above the gear wheel of the deflection coil where a photo interrupting plate is mounted. As the rotation of the deflection coil proceeds and the sweep trace comes to the screen top, the photo interrupting plate intercepts the light of the light emitting diode in U1651 and turns the photo transistor in U1651 off. Output of U1602 (C) is then set to "L" and R-S flip-flop of U1601 (C) and (D) is set to the opposite status; "L" in U1601 (C) output and "H" in U1601 (D) output.

Since the R-S flip-flop U1602 (A) and (B) also changes the state conversely when U1601 (C) output goes "L", gate U1601 (B) is closed and the sweep trace stops in the screen top.

The R-S flip-flop U1602 (A) and (B) changes the status again to the former status when the antenna faces ship's bow with heading pulse generator S801(for MODEL 2400) or S921(for FR-240 MARK-Ⅲ/FR-360 MARK-Ⅱ) in the scanner unit closed. Gate U1601 (B) opens its gate and the sweep trace starts rotation.

In this manner, the auto heading alignment circuit brings the heading flash automatically to the screen top.

Once the synchronization is achieved, gate U1602 (C) is closed to disable the auto heading alignment circuit. The stop pulse coming from U1651 is blocked at U1602 (C) and no further change occurs.

The circuit consisting of cr4, r13, c3 and r8 determines the initial status of R-S flip-flop U1601 (C) and (D). It sets U1601 (C) output to "H" and U1601 (D) output to "L" by holding U1601 (C) input "L" until c3 is charged up. When the antenna is stopped, the circuit also sets the flip-flop to the initial status in order to resynchronize the heading flash.

1-5. Video Amplifier

The output from the IF amplifier in the scanner unit is applied to the video amplifier thru coaxial cable. The video amplifier includes FTC, limiter and DC restorer. It has a bandwidth of 18 to 25MHz and the overall gain of about 32dB. In this circuit input, video signal of around 1V is amplified up to 40V.

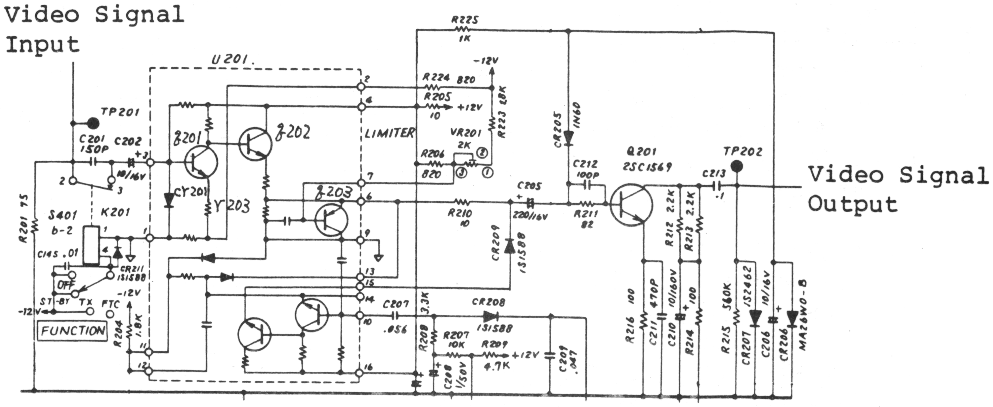

Video Signal Input
U201.
TP201
C201 150P
C202
10/16V
+3
2
3
R201 75
S401 b-2
K201
1
4
C145 .01
CR211 1S1588
OFF
ST-BY
TX
FTC
-12V
-12V
FUNCTION
R204 1.8K
11
12
Q201
Q202
CY201
Y203
Q203
LIMITER
2
4
7
6
9
13
15
14
10
16
R225 1K
R224 820
R205 10
+12V
-12V
R223 68K
VR201 2K
R206 820
①
②
③
R210 10
C205 220/16V
CR209 1S1588
CR205 1N60
C212 100P
R211 82
Q201 2SC1569
TP202
C213 .1
C207 .056
R208 3.3K
CR208 1S1588
R207 10K
R209 4.7K
+12V
C208 1/50V
C209 .047
R216 100
C211 470P
C210 10/160V
R214 100
R212 2.2K
R213 2.2K
R215 560K
CR207 1S2462
C206 10/16V
CR206 MA26W0-B
Video Signal Output

Fig.1-26 Video Amplifier

Fast Time Constant

Clutter due to sea returns, rain or snow introduces smeared picture. The FTC function improves target discrimination under these conditions.

With the FUNCTION switch set to TX position, C201 is shortcircuited so that q201 in U201 receives the video signal via contacts of K201 and C202. With the FUNCTION switch turned to FTC position, relay K201 trips to incorporate C201 into the circuit. The video signal is differentiated by C201, C202 and r203 having a comparatively short time constant, and the resultant negative spike is amplified in the video amplifier. The positive spike corresponding to the trailing edge of the video signal, which otherwise causes a dark spot behind target on the screen, is removed by cr201.

Limiter and DC restorer

In addition to the FTC circuit, the video amplifier contains video limiter which controls the picture contrast on the screen.

Contrast of picture is controlled by varying the base bias of q203. The q203 is normally reverse-biased and the signal in the emitter of q202 is led to the base of Q201. If the signal amplitude is high enough to forward-bias emitter-base of q203, q203 conducts and the signal amplitude is limited to the level of q203 base bias.

The output level of the video amplifier is adjusted by VR201 for signal amplitude of 38 to 40V at Q201 collector.

CR207 in the video amplifier output is a DC restorer which removes positive excursions from the video output signal developed across R215.

1-6. CRT Circuit

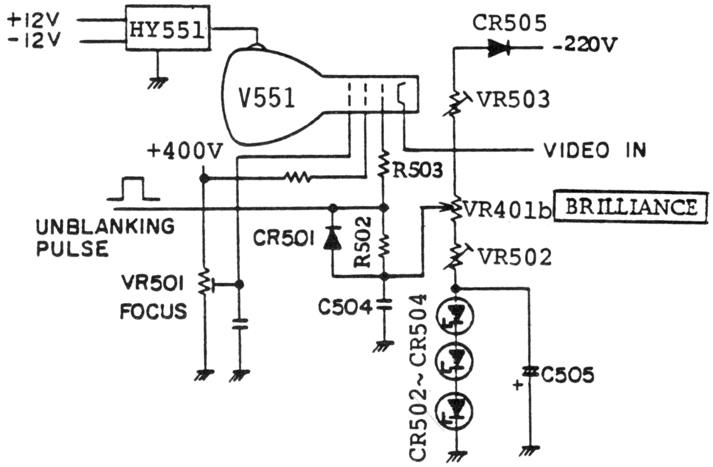


Fig.1-27 CRT Circuit

Unblanking

The positive going rectangular wave developed on the collector of Q103 is DC restored by CR501 and applied thru R503 to the grid of the CRT as an unblanking pulse. With the DC restoring level correctly set by BRILLIANCE control VR401b and brilliance preset controls VR502/503, the picture (echoes) becomes visible on the CRT during the unblanking pulse period.

Anti-flash Circuit

The CRT remains hot for some time even after the radar is turned off, that is, the CRT cathode remains warm and is capable of emitting electrons, and also the CRT anode is kept at a high potential due to charge in the voltage multiplier and is capable of accelerating the electrons emitted from the cathode. If the CRT grid voltage, negative voltage of about -100V, is removed as soon as the radar is turned off, a large quantity of electrons will be emitted from the cathode and strike the screen center, causing burn of the screen. To avoid this burn, the anti-flash circuit consisting of C505 and CR505 is employed.

Since diode CR505 is provided in -220V line, C505, charged to -99V by zener diode CR502 thru CR504, can not find appropriate discharging path after the radar is turned off.

Discharge can be made only at a slow rate thru back resistance of CR502 to CR504 and therefore the CRT grid potential is maintained for a while negative enough to hold down emission of electrons from the cathode.

Focus

Focusing of picture is accomplished with potentiometer VR501 which varies the CRT focusing electrode voltage between 0V and +400V.

1-7. VRM Circuit (Option)

The variable range marker provides calibrated variable range ring for precision ranging of echoes on the CRT. Range to the ring is digitally read out in 0.01 mile steps for 0.00 thru 9.99 miles and in 0.1 mile steps above 10 miles.

VRM Pulse Generator

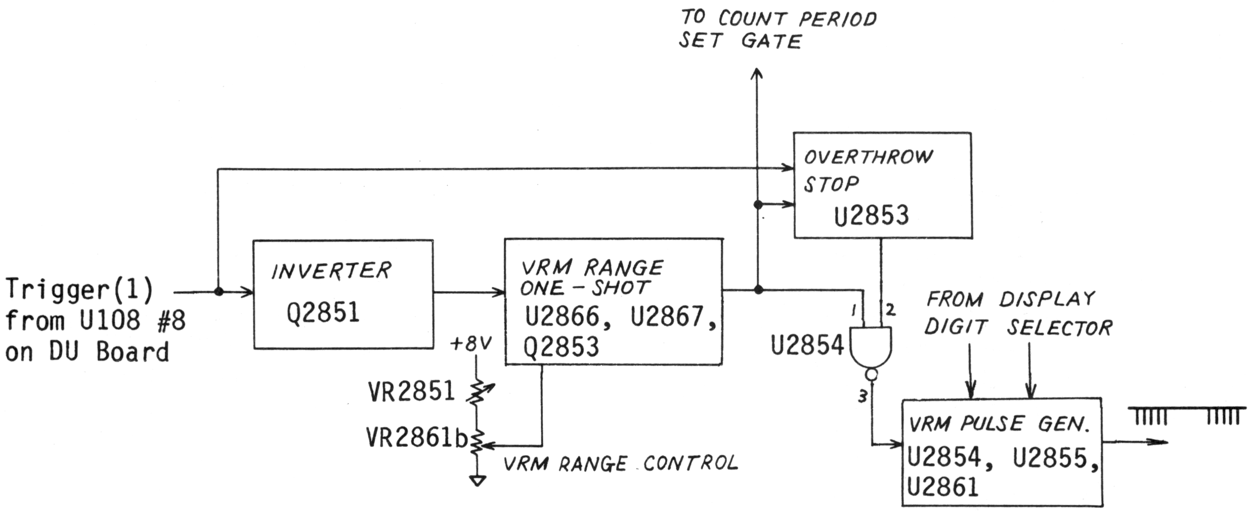

TO COUNT PERIOD SET GATE
OVERTHROW STOP
U2853
Trigger(1) from U108 #8 on DU Board
INVERTER
Q2851
VRM RANGE ONE - SHOT
U2866, U2867, Q2853
+8V
VR2851
VR2861b
VRM RANGE CONTROL
1
2
U2854
3
FROM DISPLAY DIGIT SELECTOR
VRM PULSE GEN.
U2854, U2855, U2861

Fig.1-28 VRM Pulse Generator Block Diagram

The VRM pulse generator consists of the inverter, VRM range one-shot, overthrow stop circuit and VRM pulse generator as shown above.

Activated by the trigger (1) from U108 #8 on DU board, the VRM range one-shot produces a rectangular wave having a length determined by VR2861b (VRM Range Control on the RU-3770). This rectangular wave enters the VRM pulse generator thru gate U2854. The generator contains two differentiators with different time constants. Either of the two differentiates the rectangular wave and produces a VRM pulse at its trailing edge.

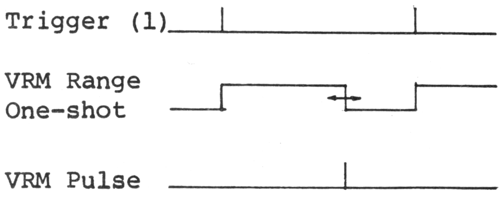

Trigger (1)
VRM Range One-shot
VRM Pulse

Fig.1-29

The pulselength is dependent on the differentiator to be used and changes automatically with range. It is about 95ns long when the range display is less than 10 miles and 350ns above that.

The overthrow stop circuit is employed to eliminate an undesired ring that may occur when the rectangular wave in the output of the VRM range one-shot is longer than the trigger pulse intervals.

If the rectangular wave is longer than the trigger intervals, the VRM ring will appear at point (t) from the center of the screen on the next trace while the counter indicates the distance "T" in nautical miles as shown in Fig.1-30. To avoid this malfunction, the overthrow stop circuit generates, in such a case, a rectangular wave with a length equal to the trigger interval and brings the VRM pulse exactly below the trigger pulse (1).

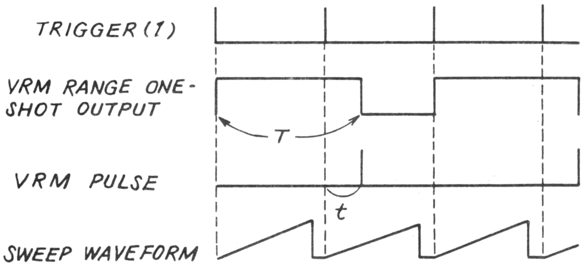

TRIGGER (1)
VRM RANGE ONE-SHOT OUTPUT
T
VRM PULSE
t
SWEEP WAVEFORM

Fig.1-30

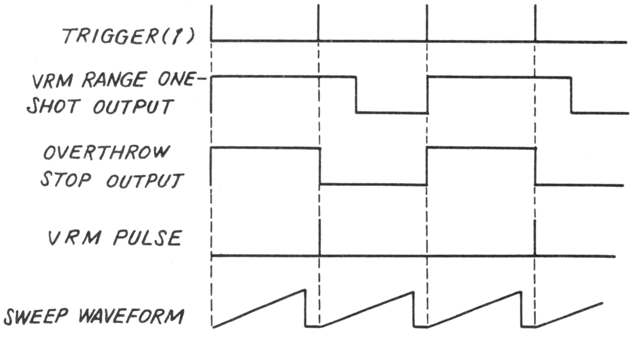

TRIGGER(1)
VRM RANGE ONE-SHOT OUTPUT
OVERTHROW STOP OUTPUT
VRM PULSE
SWEEP WAVEFORM

Fig.1-31

The following describes the VRM range one-shot multivibrator in detail.

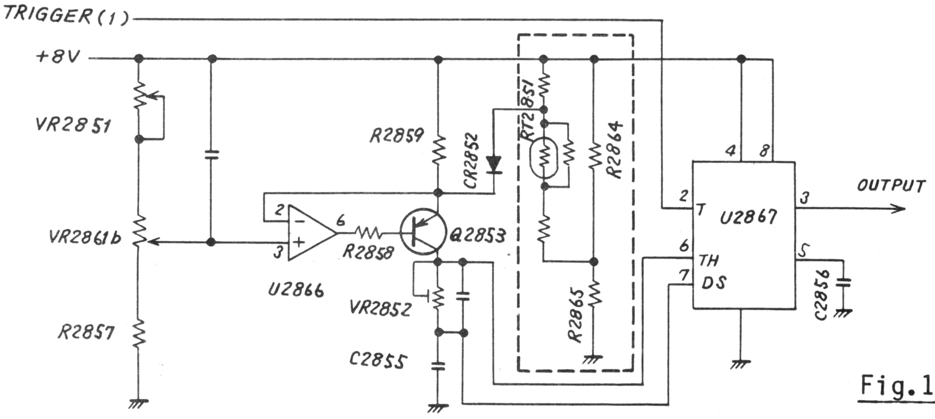

TRIGGER (1)
+8V
VR2851
VR2861b
R2857
R2859
CR2852
RT2851
R2864
R2865
2
3
6
U2866
R2858
Q2853
VR2852
C2855
4
8
2
T
U2867
3
OUTPUT
6
TH
7
DS
5
C2856

Fig.1-32

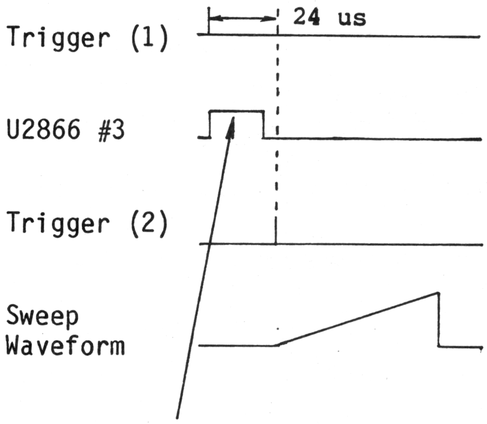
U2866 and Q2853 forms a constant current circuit. U2867 is the timer IC. Its output pin #3 goes "H" when a trigger pulse is applied to pin #2 and returns to "L" when threshold pin #6 rises to 2/3Vcc (Vcc=8V). At the moment output pin #3 turns "L", pin #7 is grounded and C2855 is discharged.
The length of the output rectangular wave is a function of Q2853 collector current and C2855. It is controlled by changing the collector current by means of VR2861b on the RU-3770.

When the collector current is low so as to bias CR2852 reversely, charging current for C2855 is derived only thru R2859. However, if the current is large enough to lower CR2852 cathode potential below its anode, additional charging current is derived through CR2852. This circuit arrangement changes, by quadratic function, the charging current and resultantly the length of the output rectangular wave, when the potentiometer VR2861b is turned.

The resultant effect to operation is that when the VRM ring is obversed on the screen, the ring moves at a constant speed on all ranges with respect to rotation angle of VR2861b (VRM Range Control).

VR2851 determines the minimum value of charging current. It is adjusted with VR2861b turned fully clockwise so that the output rectangular wave has the rated maximum length. VR2852 is for presetting the minimum length of the rectangular wave that is obtained with VR2861b turned fully counterclockwise. *

* The VRM circuit employs two kinds of trigger pulses in order to start the VRM ring from 0 miles.
One is trigger (2) from U109 #8 on DU board that occurs in coincidence with the start of the sweep trace. It initiates the counter operation. The other is trigger (1). It is generated 24us earlier than trigger (2) and activates the VRM pulse generator. VR2852 is adjusted so that the length of the rectangular wave at U2866 #3 is less than 24us when VR2861b is turned fully counterclockwise.



To start VRM ring from 0 miles, pulselength should be below 24us when VR2861b is turned fully counterclockwise.

Fig.1-33

The components enclosed in broken lines in Fig.1-32 is the temperature compensator. It keeps CR2852 current constant against the variation of ambient temperature.

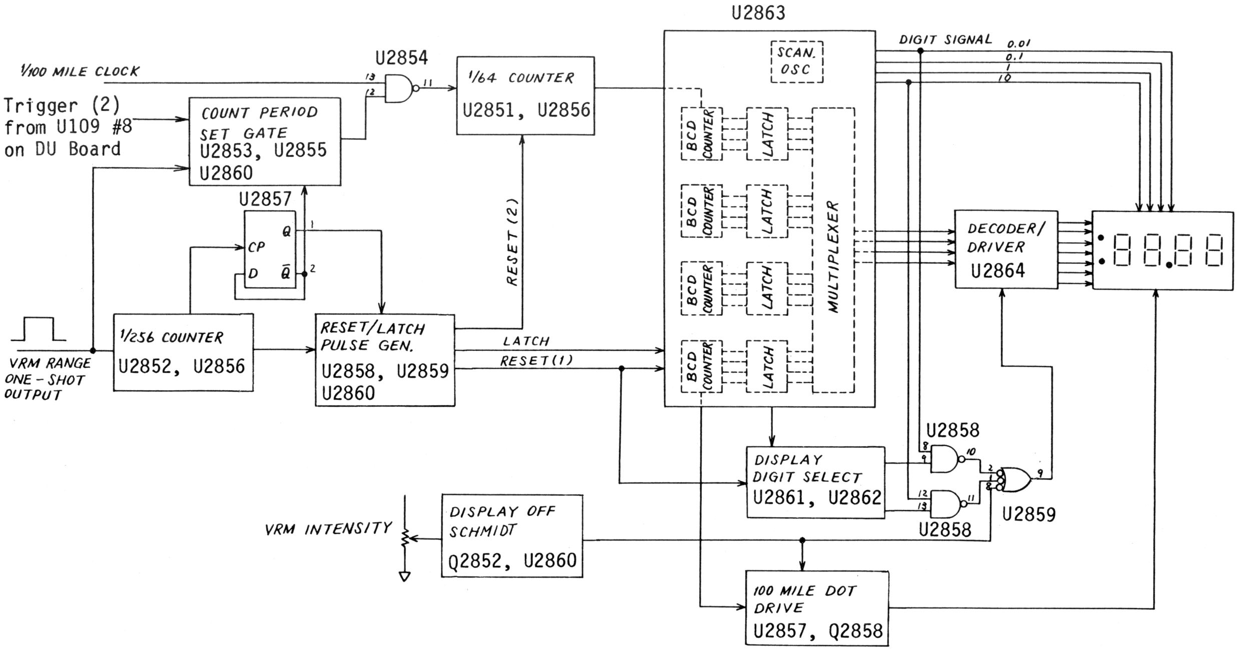

U2863
1/100 MILE CLOCK
U2854
13
12
11
1/64 COUNTER
U2851, U2856
Trigger (2)
from U109 #8
on DU Board
COUNT PERIOD
SET GATE
U2853, U2855
U2860
U2857
CP
D
Q
Q̄
1
2
RESET (2)
VRM RANGE
ONE-SHOT
OUTPUT
1/256 COUNTER
U2852, U2856
RESET/LATCH
PULSE GEN.
U2858, U2859
U2860
LATCH
RESET (1)
SCAN.
OSC
BCD
COUNTER
LATCH
MULTIPLEXER
DIGIT SIGNAL
0.01
0.1
1
10
DECODER/
DRIVER
U2864
DISPLAY
DIGIT SELECT
U2861, U2862
U2858
U2858
U2859
VRM INTENSITY
DISPLAY OFF
SCHMIDT
Q2852, U2860
100 MILE DOT
DRIVE
U2857, Q2858

Fig.1-34 Counter/Display Circuit Block Diagram

Counter/Display Circuit

The counter/display circuit is divided into functional blocks shown in Fig.1-34. The operation of this circuit is to measure and display digitally the interval between the trigger (2) pulse and the trailing edge of the rectangular wave in the output of the VRM range one-shot. Theoretically, the counter operation can be updated in synchronizm with the display sweep cycle (or trigger pulse). However, in the actual circuit, to avoid fluctuation of the smallest digit, it is continued for 64 sweep cycles and the resultant count is divided by 64 before being displayed. Divide-by-64 operation is made by placing an additional scale-of-64 counter in front of the main counter.

The following describes the operation of the counter/display circuit.

1. The output of the count period set gate goes "H" with trigger (2) and returns to "L" with the trailing edge of the rectangular wave applied from the VRM range one-shot. The 1/100 mile clock pulses enter the 1/64 counter thru U2854 during the period while the output is "H". The 1/64 counter and the BCD counters in U2863 number the clock pulses until 64 trigger (2) pulses are applied.

2. The 1/256 counter numbers the trailing edge of the rectangular wave applied from the VRM range one-shot and triggers the flip-flop U2857 on its 64th count. With U2857 changed conversely, the output of the count period set gate is locked "L", stopping the counter operation.

3. While the output of the count period set gate is locked "L", the standing count in U2863 is latched and then all counters are cleared.

4. The 1/256 counter continues the operation while the step #3 is under way. It again triggers flip-flop U2857 on its 128th count and resets the count period set gate into operation.

In this manner, the counter completes one cycle of operation on 128 trigger (2) pulses and repeats the same operation for the forthcoming trigger pulses. See Fig.1-35 and Fig.1-36.

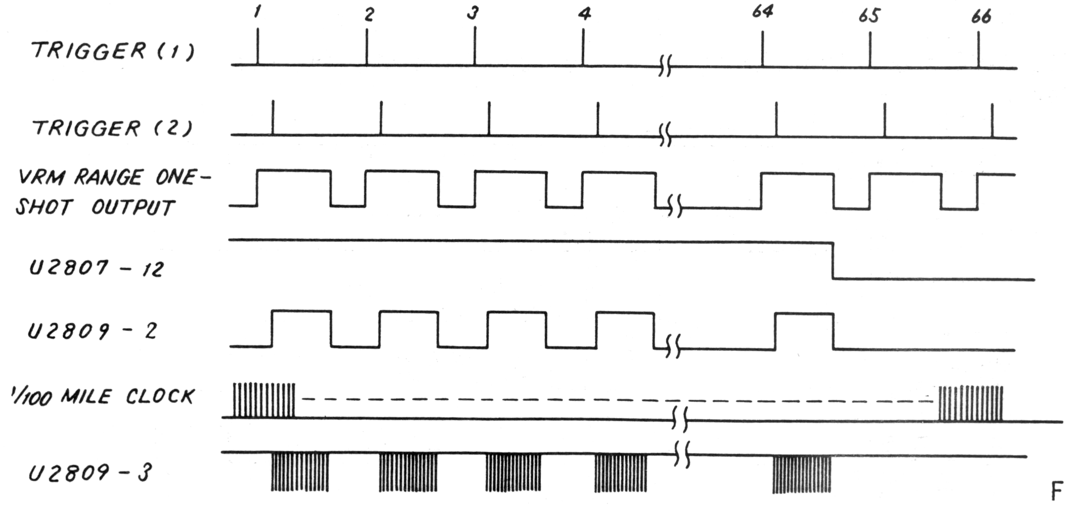


Fig.1-35

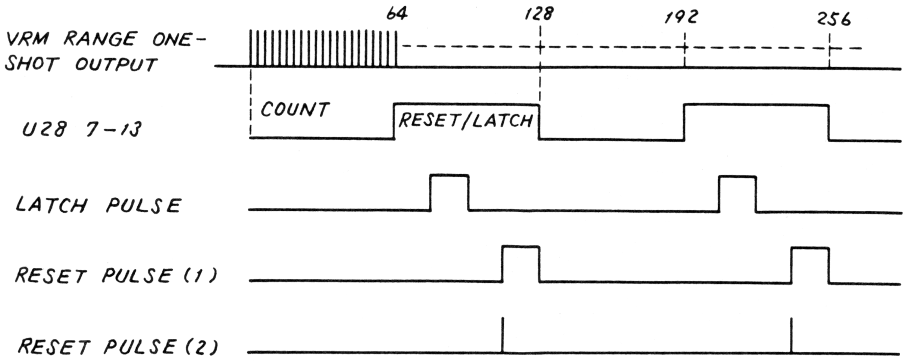


Fig.1-36

5. The count data stored in the latch of U2863 is sent out digit by digit to the decoder/driver by the clock pulses of the scanning oscillator (inside U2863). The display indicates the decoded data in a time sharing manner.

   The digit signals (4 lines) represent the digit of data being sent out of U2863. Each line is connected to the display LED of each respective digit via a transistor as shown in Fig.1-37 and goes "H" only while the data of that digit is being outputed. This results in the cathode of a display LED for which count data is available being grounded thru the transistor and the LED is enabled.

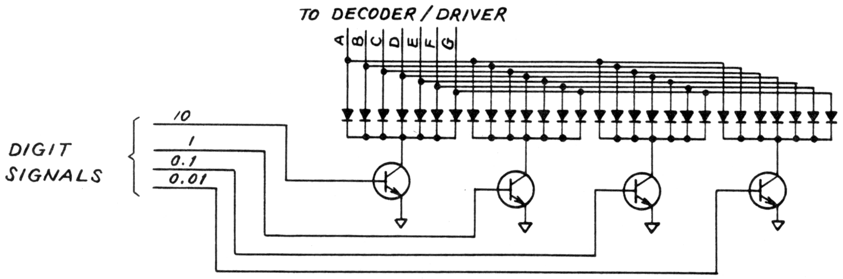


Fig.1-37

Fig.1-38 shows the timing chart for the time sharing output of count data.

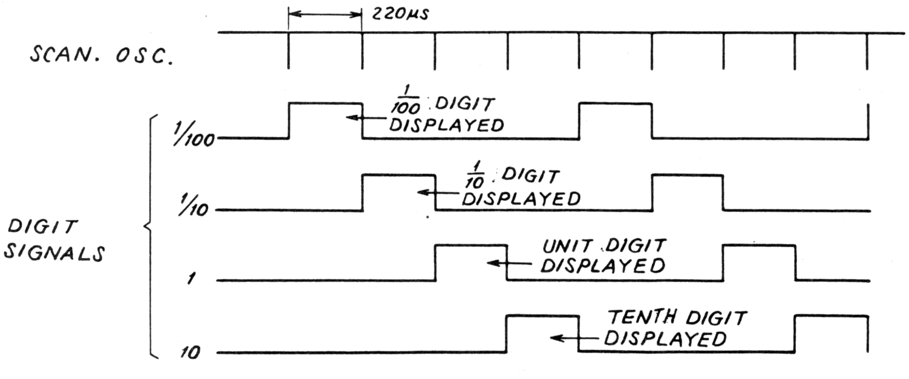


Fig.1-38

6. Four display LED's are incorporated and three of them are used at a time. When the VRM range is less than 10.0 miles, the LED's lower three digits are used, while above 10.0 miles, those of the upper three digits. The switching of the LED's is made as follows by operation of the display digit selector circuit.

   1) While the VRM range is less than 10.0 miles, U2858-9 is kept "L" and U2858-13 is kept "H". Under this condition, if the digit signal of ten's order goes "H", U2858-11 goes "L" and thereby U2859-9 goes "H". The decoder/driver is disabled while the "H" is present on U2859-9 and therefore the count data of ten's order is blocked.

   2) In the course of counting, if standing count exceeds 9.99 miles, a trigger signal is sent out to the display digit selector circuit from U2863 and changes U2858-9 to "H" and U2858-13 to "L". Under this condition, the decoder/driver is disabled when the count data of hundredth's order is sent out of U2863 and this digit is prevented from being displayed.

7. The 100 mile dot drive circuit turns active and drives the 100 mile dot at the moment U2863 overflows, that is at the moment the standing count exceeds 99.9 miles.

8. The schmitt trigger circuit consisting of Q2852 and U2860 changes the state conversely and disables the decoder/driver when the VRM Intensity Control is turned fully counterclockwise.

1-8. 8MHz Clock Circuit (Option)

This circuit is composed of a crystal oscillator which produces a continuous train of 8.09375MHz signal for the VRM circuit. Since the wavelength of 8.09375MHz signal is 0.123552us and it corresponds to the time taken for radio waves to go 0.01 nautical miles and return the same distance, the signal is hereafter referred to as "1/100 mile clock pulse".

1-9. Interference Rejector (Option)

The interference rejector eliminates radar interference, which is liable to occur in the vicinity of other radars operating on the same frequency band, and ensures clear and distinct pictures.

Principle

For identification of an interfering signal to be eliminated in a radar, characteristics that are unique to the interference signal must be utilized. One of the unique characteristics is its randomness, that is, the interference signals seldom appear at the same range even on successive sweep traces. They always appear like targets moving at extremely high speed. The interference rejector circuit utilizes this characteristic for identification and rejection of interference signals.

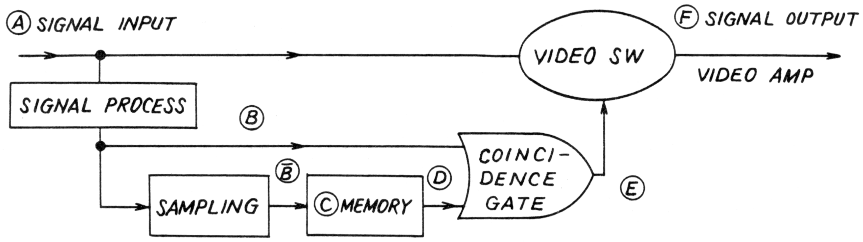

Ⓐ SIGNAL INPUT
SIGNAL PROCESS
Ⓑ
VIDEO SW
Ⓕ SIGNAL OUTPUT
VIDEO AMP
COINCI-DENCE GATE
SAMPLING
$\bar{B}$
Ⓒ MEMORY
Ⓓ
Ⓔ

Fig.1-39

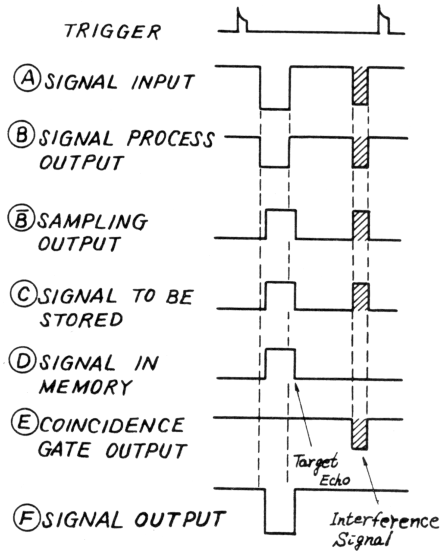

TRIGGER
Ⓐ SIGNAL INPUT
Ⓑ SIGNAL PROCESS OUTPUT
$\bar{B}$ SAMPLING OUTPUT
Ⓒ SIGNAL TO BE STORED
Ⓓ SIGNAL IN MEMORY
Ⓔ COINCIDENCE GATE OUTPUT
Target Echo
Ⓕ SIGNAL OUTPUT
Interference Signal

Fig.1-40

Following each transmission of r.f. energy from the antenna, echoes are received successively. The received echoes contain both interference signals (unwanted signals) and target echoes (wanted signals). These signals are sent to the video switch and, at the same time, to the signal process circuit. The signal process circuit rejects noises and very weak signals below a threshold level and amplifies and limits the rest of the signals. The output of the signal process circuit is applied to the coincidence gate and the sampling circuit. The sampling circuit samples the signals at constant intervals and sends them to the memory for storing.

Successively after the above operation, the next transmission is made and new echoes are received. Let's suppose that the received echoes contain an interference signal in addition to target echoes received in the previous cycle. These signals proceed the same paths as before and as they enter the memory, the signals already stored are pushed out one by one and applied to the coincidence gate.

The coincidence gate produces no signal in the output if the two input terminals are supplied with signals simultaneously. Then, only the interference signal can pass the gate and reach the video switch, where the received echoes are applied directly. The interference signal sent out of the coincidence gate closes the video switch at the moment the interference signal in the direct echoes is applied and eliminates it.

Block Diagram Description

Fig.1-41 shows the block diagram of the interference rejector.

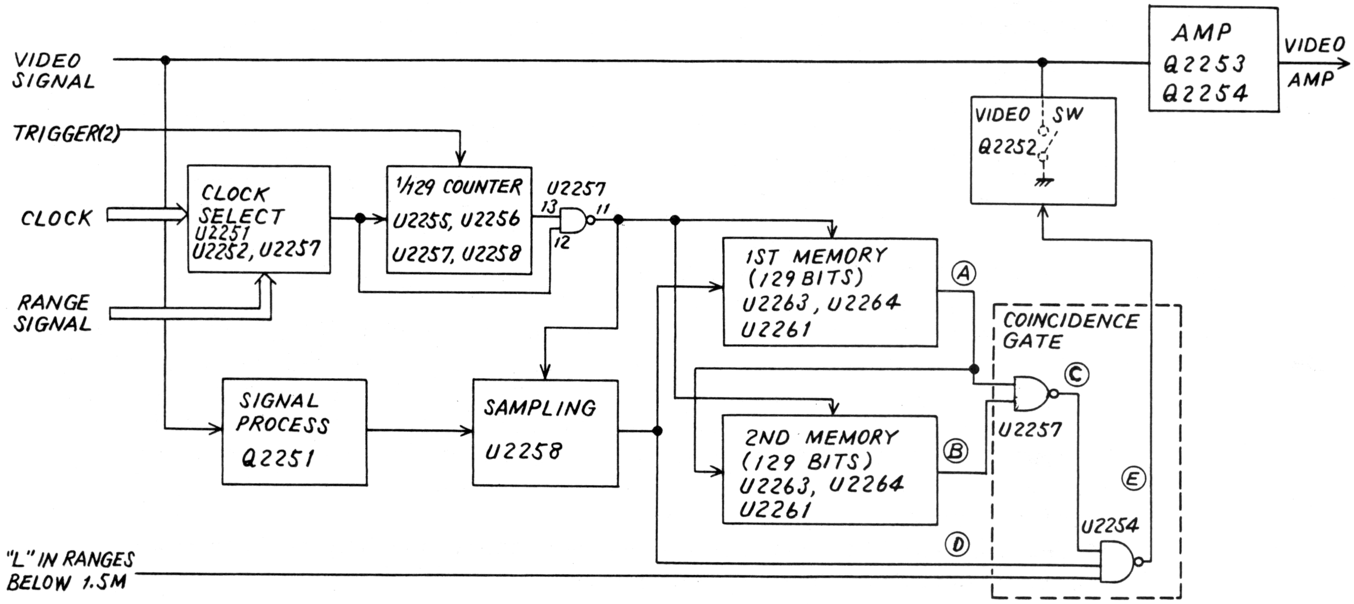

VIDEO SIGNAL
TRIGGER(2)
CLOCK
RANGE SIGNAL
CLOCK SELECT U2251 U2252, U2257
1/129 COUNTER U2255, U2256 U2257, U2258
U2257
13
11
12
1ST MEMORY (129 BITS) U2263, U2264 U2261
Ⓐ
2ND MEMORY (129 BITS) U2263, U2264 U2261
Ⓑ
Ⓓ
SIGNAL PROCESS Q2251
SAMPLING U2258
COINCIDENCE GATE
Ⓒ
U2257
Ⓔ
U2254
VIDEO SW Q2252
AMP Q2253 Q2254
VIDEO AMP
"L" IN RANGES BELOW 1.5M

Fig.1-41

1. The interference rejector is fed with several clock pulses with different frequencies from the timebase circuit.

   The clock selection circuit selects pulse rates suitable for the range in use. As already mentioned on Page 1-19, IR clock rate in short-range area is twice as high as that in long-range area. This will ensure efficient interference rejection, especially in off-centering mode.

2. The 1/129 counter and U2257 passes 129 clock pulses, starting just after the trigger pulse (2). They are used as clock signals for the sampling circuit and the memory.

3. The signal process circuit rejects noise and signal below a threshold level and amplifies the rest of the signal and convert it into the digital values of "H" (signal) and "L" (no signal).

4. The sampling circuit samples the output signals of the signal process circuit and applies the resultant signal to the memory.

5. The memory is divided into 1st and 2nd memories. The reason for employing two memories is to increase the number of correlations and enhance the interference signal rejection effect.

   In Fig.1-42, the output Ⓒ is a signal obtained by correlating the two signals received in the past two sweep periods. The interference signals in outputs Ⓐ and Ⓑ are not present in Ⓒ. The output Ⓔ represents interference signals that are extracted from echoes being received now. They are obtained by correlating the output Ⓒ and Ⓓ. In other words, it can be said that, among the present signals in the output Ⓓ, the signals which were not received in the past two sweep periods Ⓐ and Ⓑ are considered interference signals and sent out to the output Ⓔ. Thus, by placing two memories in series, the circuit can reject the interference signal that appears at the same range in two successive sweeps unless it appears at the same point on three successive sweeps.

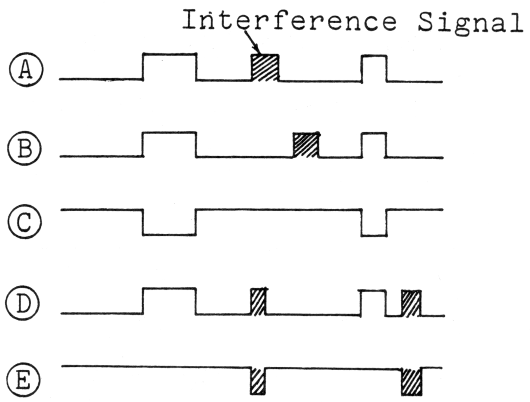


Fig.1-42

6. The video switch closes and grounds the video signal line when the interference signal Ⓔ is applied.

7. The interference rejector is operative in the ranges 1.5 miles and above. In the other ranges, one of the input terminals of U2254 is held "L" and rejector is turned off.

CHAPTER 2. ADJUSTMENT

2-1. General

This chapter describes the radar adjustment in a workshop, where various measuring instruments are available. This also helps you with radar setting-up on board in the following cases.

(1) When a major component has been replaced.

(2) When it is considered that a fault is caused by improper adjustment of preset controls.

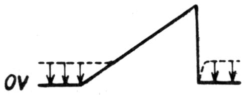
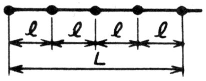
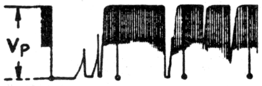
Table 2-1 Measuring Instruments (for servicing on board)

No.	Name	Recommended Type	Specifications/Remarks
1	Multimeter	Sanwa YX-360TR	Vdc: 0.1V to 1000V (25kohms/V) Vac: 10V to 1000V (8kohms/V) Idc: 50uA to 250mA R : 2kohms to 20Mohms
		Sanwa AX-303TR	Vdc: 0.3V to 1200V (20kohms/V) Vac: 6V to 1200V (8kohms/V) Idc: 60uA to 300mA & 12A R : 2kohms to 20Mohms
2	Digital Multimeter	Sanwa 4300TR	Vdc: 2V to 1000V Vac: 2V to 1000V Idc: 200mA R : 2kohms to 20Mohms
		Sanwa 7200ES	Vdc: 200mV to 1000V Vac: 200mV to 600V Idc: 0.2mA to 200mA Iac: 0.2mA to 200mA R : 0.2kohms to 20Mohms
3	Oscilloscope	TEKTRONIX 324	Vert: DC to 10MHz, Single Trace, 2mV/div to 20V/div, 500V max. Rise time 36ns Hor : 1us/div to 0.2s/div 0.2us/div min. with x5 sweep 0.5s/div max. with sweep adj. TRIG: Auto/manual, Int/Ext. CRT : 6x10 div (38mmx63.5mm)

Table 2-2 Measuring Instruments (for servicing in workshop)

No.	Name	Recommended Type	Specifications/Remarks
1	Multimeter	See Table 2-1.	
2	Digital Multimeter		
3	Oscilloscope	TEKTRONIX 324	See Table 2-1.
		TEKTRONIX 455	Vert: DC to 50MHz, Dual Trace, 5mV/div to 50V/div, Hor : 0.05us/div to 0.5s/div 5us/div min. with x10 sweep TRIG: Auto/manual, Int/Ext. CRT : 8x10 div (80mmx100mm)
4	Variable Power Supply	Arrange Locally	Output Voltage: DC8V to DC50V Power Capacity: 100W to 150W
5	Frequency Counter	Takeda Riken TR-5104	Freq. : DC to 60MHz Vin : 50mV to 5V Period : 1us to 1000s
		Iwatsu UC-7641	Freq. : DC to 60MHz Vin : 10mV to 20V Period : 0.1us to 10,000S
6	Signal Generator	Matsushita VP-730A	Freq. : 10Hz to 10MHz Vout : 6Vp-p max. (75ohm load)

Table 2-3 Adjusting Points and Ratings

No.	Items	Ratings	Adjuster	Check Point	Refer to
1	Inverter Frequency	24.75kHz to 25.25kHz	VR1301	TP1303#1 & #4	Page 2-4
	+12V Line	11.68 to 11.92V	VR1	TP1 #6(+) & #4(-)	
2	Sweep Linearity (Threshold)		VR103	TP108	Page 2-5
3	Range Ring Timing	First rings in both 1/4M & 1/2M ranges should appear at the same position.	VR301	CRT Screen	Page 2-6
4	Sweep Velocity	L=74±1mm ℓ=L/4±1mm  (1/2M range)	VR102	CRT Screen	Page 2-6
5	Video Limiter	Vp=38V to 40V 	VR201	TP202	Page 2-7
6	CRT Brilliance		VR502 VR503	CRT Screen	Page 2-8
	Focus		VR501		
7	IF Gain	5.7 to 5.9V with GAIN set at maximum.	VR202	J60 #2	Page 2-8
8	VRM (Option)				Page 2-9
	Max Range	40 n.m.(45 n.m. for FR-360 II)	VR2851	VRM Display	
	Min Range	0.00 n.m.	VR2852		

2-2. Inverter Frequency and +12V Line

Necessary Test Instruments:

1) Multimeter
2) Frequency counter or well-calibrated oscilloscope

Condition:

Stand-by, 1/2 n.m. range, scanner rotating, minimum CRT brilliance.

Procedure:

1) Connect the multimeter, set at DC 30V or 50V range, between #6 (+) and #4 (-) of TP1, and the frequency counter or well-calibrated oscilloscope between TP1303 #1 and # 4. See Fig.2-1.

2) With the rated power supply voltage, operate the radar in the above condition.

3) Adjust VR1 to get 11.8V reading on the multimeter.
 - +12V LINE ADJUSTMENT -

4) With VR1 adjusted for the reading of 11.8V on the meter, adjust VR1301 so that the frequency counter reads 25.0kHz (40usec in period when measured by oscilloscope). -FREQUENCY ADJUSTMENT-

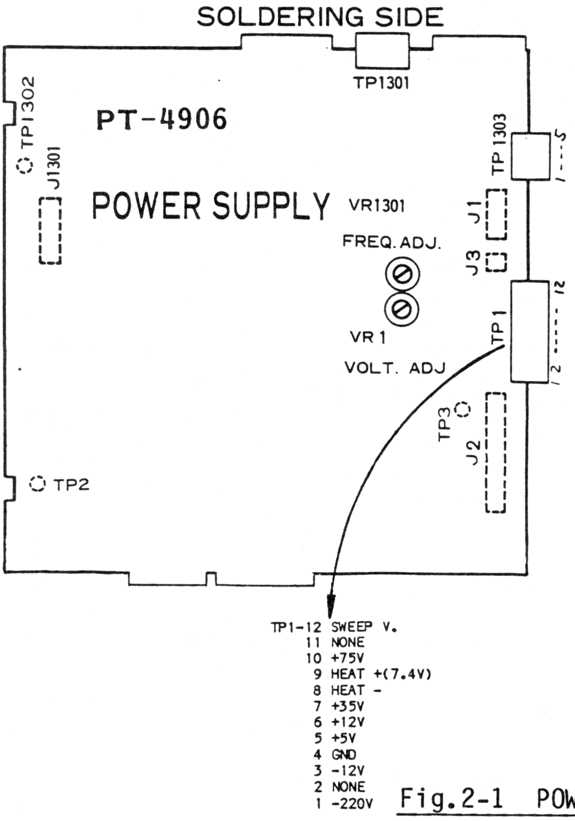

SOLDERING SIDE
TP1301
PT-4906
POWER SUPPLY
TP1302
J1301
TP 1303
1---5
VR1301
FREQ. ADJ.
J1
J3
VR 1
VOLT. ADJ
TP 1
1 2 ----- 12
TP3
J2
TP2
TP1-12 SWEEP V.
11 NONE
10 +75V
9 HEAT +(7.4V)
8 HEAT -
7 +35V
6 +12V
5 +5V
4 GND
3 -12V
2 NONE
1 -220V

Fig.2-1 POWER SUPPLY Board PT-4906

2-3. Sweep Linearity (Threshold) Adjustment

Necessary Test Instrument: Oscilloscope

Condition:

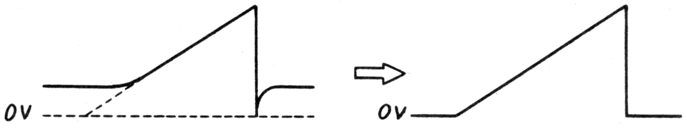
Transmit, fuse F1 (0.5A) removed, 1/2 n.m. range, scanner stopped, minimum CRT brilliance.

Procedure:

1) Connect the check probe of oscilloscope to TP108, and calibrate the vertical sweep position of oscilloscope with input mode (AC-GND-DC) set at "GND". Then set it to "DC" mode.

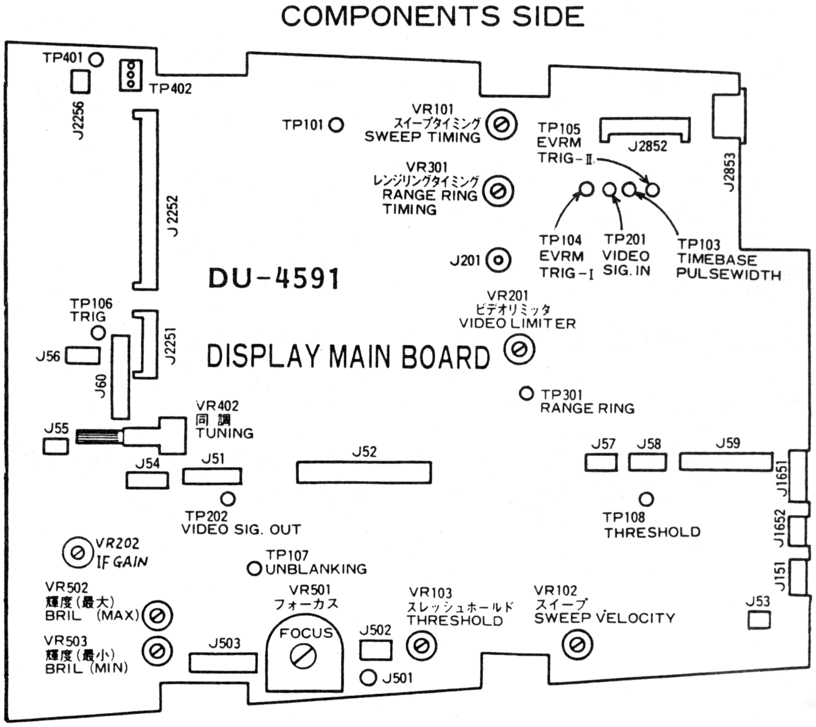
2) Set the radar to above condition.

3) Turn clockwise VR103 until the oscilloscope displays a waveform shown in Fig.2-2(a). Then, slightly turn VR103 counterclockwise so that the base line drops to 0V.



a) Bad Setting b) Good Setting

Fig.2-2 Waveforms at TP108



COMPONENTS SIDE
TP401
TP402
J2256
J2252
TP101
VR101
スイープタイミング
SWEEP TIMING
VR301
レンジリングタイミング
RANGE RING
TIMING
TP105
EVRM
TRIG-Ⅱ
J2852
J2853
TP104
EVRM
TRIG-Ⅰ
TP201
VIDEO
SIG. IN
TP103
TIMEBASE
PULSEWIDTH
J201
DU-4591
DISPLAY MAIN BOARD
VR201
ビデオリミッタ
VIDEO LIMITER
TP106
TRIG
J56
J2251
J60
TP301
RANGE RING
VR402
同調
TUNING
J55
J54
J51
J52
J57
J58
J59
J1651
J1652
J151
TP202
VIDEO SIG. OUT
TP108
THRESHOLD
VR202
IF GAIN
TP107
UNBLANKING
VR502
輝度(最大)
BRIL (MAX)
VR503
輝度(最小)
BRIL (MIN)
VR501
フォーカス
FOCUS
J503
J502
J501
VR103
スレッシュホールド
THRESHOLD
VR102
スイープ
SWEEP VELOCITY
J53

Fig.2-3 Display Main Board (BDU-4591 for MODEL 2400 &
FR-240 MARK-Ⅲ
CDU-4591 for FR-360 MARK-Ⅱ)

2-4. Range Ring Timing

Condition:

Transmit, fuse F1 (0.5A) removed, scanner stopped, BRILLIANCE/RING pulled and adjusted for normal intensity of range rings.

Procedure:

1) Set the radar to the above condition.
2) Adjust VR301 so that the first range rings in both ¼M and ½M ranges appear at the same position on the screen. Refer to Fig.2-3 for the location of VR301.

2-5. Sweep Velocity

Note: This adjustment should be made after "Sweep Linearity (Threshold) Adjustment" and "Range Ring Timing Adjustment" mentioned above have been accomplished.

Necessary Test Instrument: Gauge for Sweep adjustment.

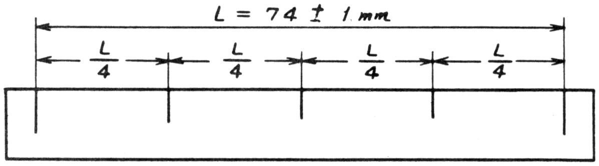


Fig.2-4

Condition: Transmit, F1 (0.5A) removed, GAIN set at minimum, ½ n.m. range.

Procedure:

1) Operate the radar in the above condition.
2) Pull BRILLIANCE/RING knob and turn it clockwise.
3) Stop the sweep trace in 90 deg direction by using SCANNER switch. Then, stick the gauge as shown in Fig.2-5.

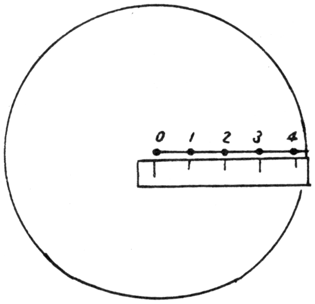


Fig.2-5

4) If the last range ring does not coincide with gauge line, adjust VR102 (See Fig.2-3.) on the display main board so that the last range ring (6th spot from center) coincides with gauge line on 12 n.m. range as shown in Fig.2-6.

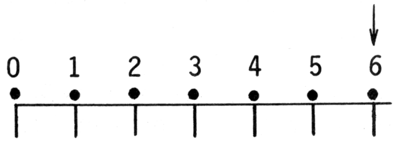


Fig.2-6

5) Confirm that the last range rings on the other ranges coincide with the gauge. If not, repeat step 4).

6) Confirm that the other rings also coincide with the gauge. If not, sweep linearity should be readjusted.

2-6. Video Limiter

Necessary Test Instrument: Oscilloscope

Condition:

Transmit, 24 n.m. range, Scanner stopped, BRILLIANCE/RING pulled and turned fully CCW, GAIN control set to 60% to 80%.

Procedure:

1) Connect the check probe of oscilloscope to TP202 (See Fig.2-3).

2) Set the radar to above condition.

3) Adjust VR201 (See Fig.2-3) so that the negative peak level is within -38V to -40V as below.

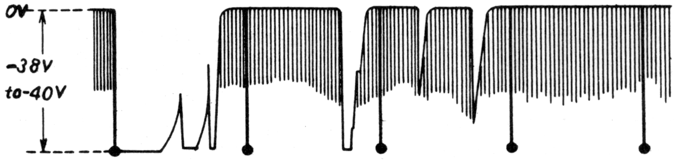


Fig.2-7 Video Output at TP202

2-7. CRT Brilliance & Focus

Condition: Transmit, scanner rotating, GAIN set at minimum, viewing hood fitted.

Procedure:

1) With GAIN set at minimum, set the radar to transmit in 3 n.m. range. Fit the viewing hood on the CRT screen.

2) With VR502 and VR503 turned fully CCW, turn BRILLIANCE control fully CW. See Fig.2-3.

3) Turn VR502 CW little by little until the sweep trace becomes dimly visible on the CRT.

4) With BRILLIANCE/RING pulled and turned fully CCW, turn VR503 gradually CW until the range rings are dimly visible on CRT. Then turn VR503 slightly CCW.

5) With BRILLIANCE/RING turned fully CW, adjust VR502 again so that the sweep trace is dimly visible on CRT.
   - CRT BRILLIANCE ADJUSTMENT -

6) Operate the radar for normal picture, and confirm that proper brilliance is obtained on all ranges.

7) Suspend the scanner rotation with SCANNER switch. While observing the range ring, adjust VR501 shown in Fig.2-3 so that the range ring spots may be plotted as sharp as possible. -FOCUS ADJUSTMENT-

2-8. IF Gain

Necessary Test Instrument: Multimeter

Condition: Transmit

Procedure:

1) Confirm that the picture at the distance more than 3 n.m. disappears with the GAIN control turned fully CCW.

2) Confirm that the picture is displayed with the best definition when the GAIN control is set to 60% to 80%.

3) Connect the multimeter between the pin #2 of J60 and ground.

4) With the GAIN control turned fully CW, adjust VR202 so that the multimeter indicates 5.8V ± 0.1V (5.7V to 5.9V).

Refer to Fig.2-3 for the locations of J60 and VR202.

2-9. VRM (Option)

Procedure:

1) Operate the radar on "TRANSMIT", and set the RANGE at maximum.

2) Turn the VRM RANGE control on the VRM display unit RU-3770 fully CW.

3) Adjust VR2851 on the EVRM board so that the numerical VRM display may read approx. 40 n.m. (45 n.m. for FR-360 MARK-II).

4) Turn the VRM RANGE control fully CCW. then, turn it CW about 180°(half turn).

5) Adjust VR2852 for 0.01 n.m. reading on the VRM display.

6) Turn the VRM RANGE control fully CW. then, confirm that the numerical VRM display reads approx. 40 n.m. (45 n.m. for FR-360 MARK-II). If not, repeat steps 4) to 6).

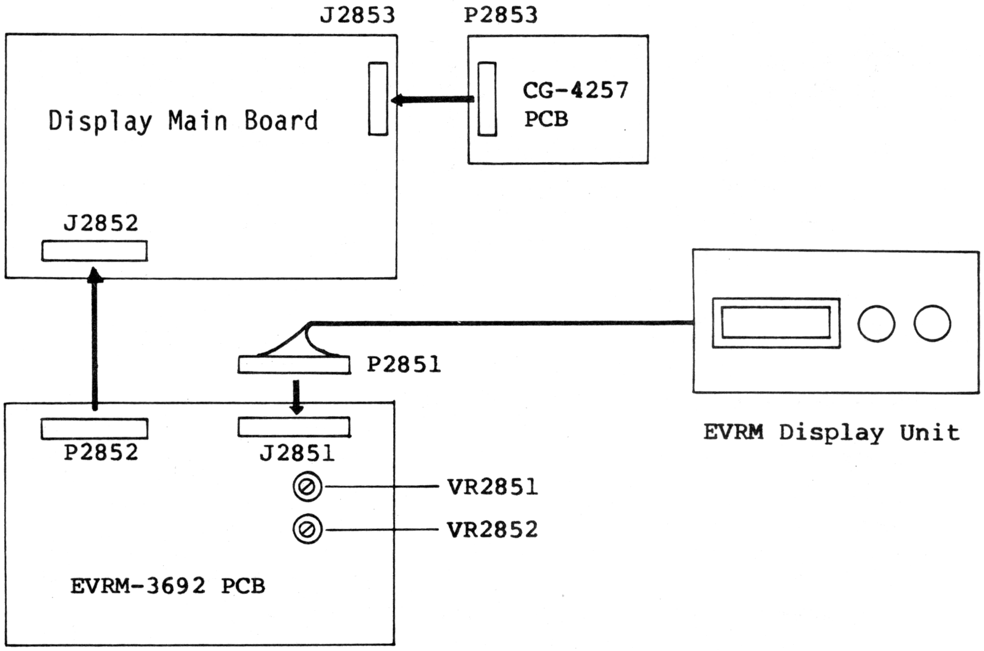

J2853
P2853
Display Main Board
CG-4257 PCB
J2852
P2851
EVRM Display Unit
P2852
J2851
VR2851
VR2852
EVRM-3692 PCB

Fig.2-8

CHAPTER 3. REMOVAL AND REPLACEMENT OF MAJOR COMPONENTS

Refer to Dwg. Nos. C3255-004 (DISPLAY UNIT) and C3255-003 (DEFLECTION TABLE ASSEMBLY) on pages D-1 and D-2, respectively.

3-1. Cursor Panel A-217

1) Remove all control knobs except for the cursor knob by unscrewing M3x4 setscrews with a socket screw wrench.

2) Remove the display cover A-203.

3) Unscrew four M4x10 washer head screws S-215, and cursor panel A-217 comes free. See Fig.3-1.

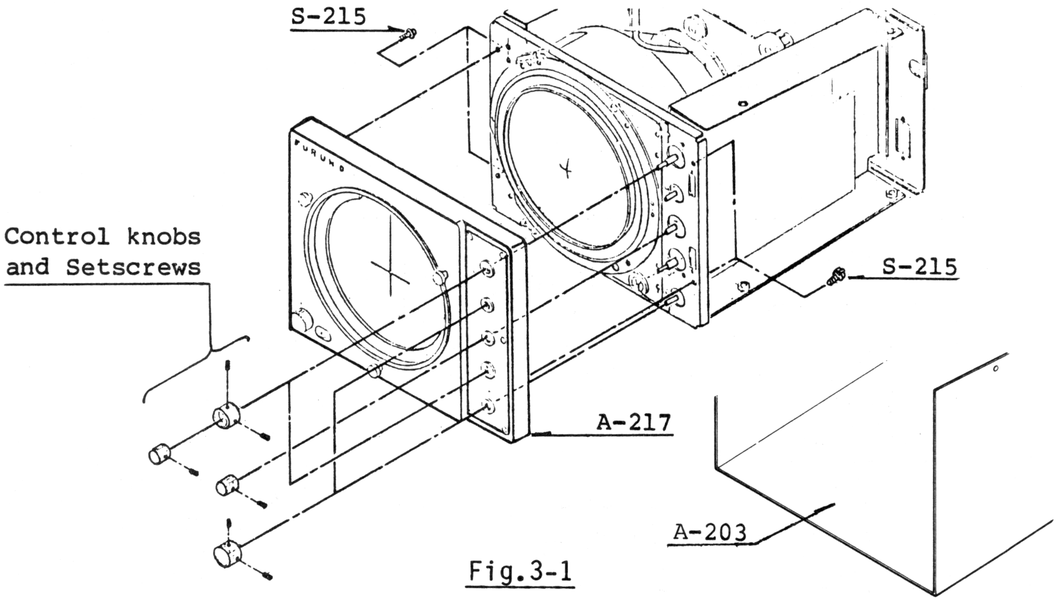

S-215
Control knobs and Setscrews
S-215
A-217
A-203

Fig.3-1

3-2. Display Main Board

1) Remove the cursor panel A-217.

2) Disconnect the connector plugs connected to the main board.

3) Unscrew two M3x6 washer head screws S-214 on the front chassis and five M3x6 washer head screws S-209 on the board, and the main board comes free.

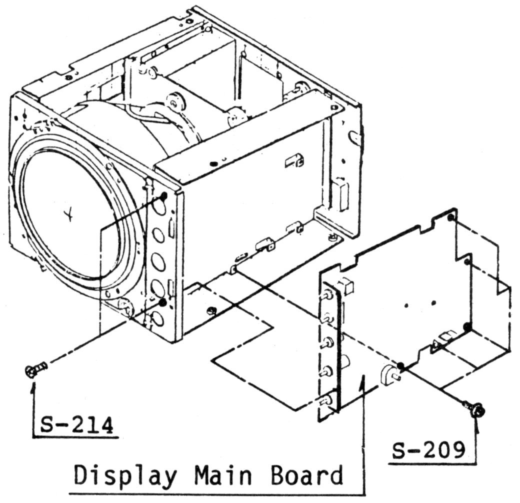

S-214
S-209
Display Main Board

Fig.3-2

3-3. CRT V551

NOTE: Wait several minutes after switching off the radar to discharge high tension.

1) Remove the cursor panel A-217.

2) Remove the blind plate A-242 on the rear chassis by unscrewing four M3x6 washer head screws S-201, and pull out the CRT socket.

3) Unscrew M3x15 washer head screw S-212, and remove the CRT neck cover A-234.

4) Pull out the magnet mount A-237 with twc centering magnets A-238/239 and spacer A-240.

   Note: The magnet mount is attached to the CRT neck by adhesive tape.

5) With great attention to the CRT high voltage, pull out the CRT anode cap. To discharge the high voltage remaining, ground the CRT anode and anode cap with a screwdriver having isolated handle.

6) Unscrew four M4x10 washer head screws S-225 on the front chassis, and the CRT with the CRT fixing plate assembly comes out.

7) Unfasten three M6 nuts N-201 and spring washers, and remove the CRT.

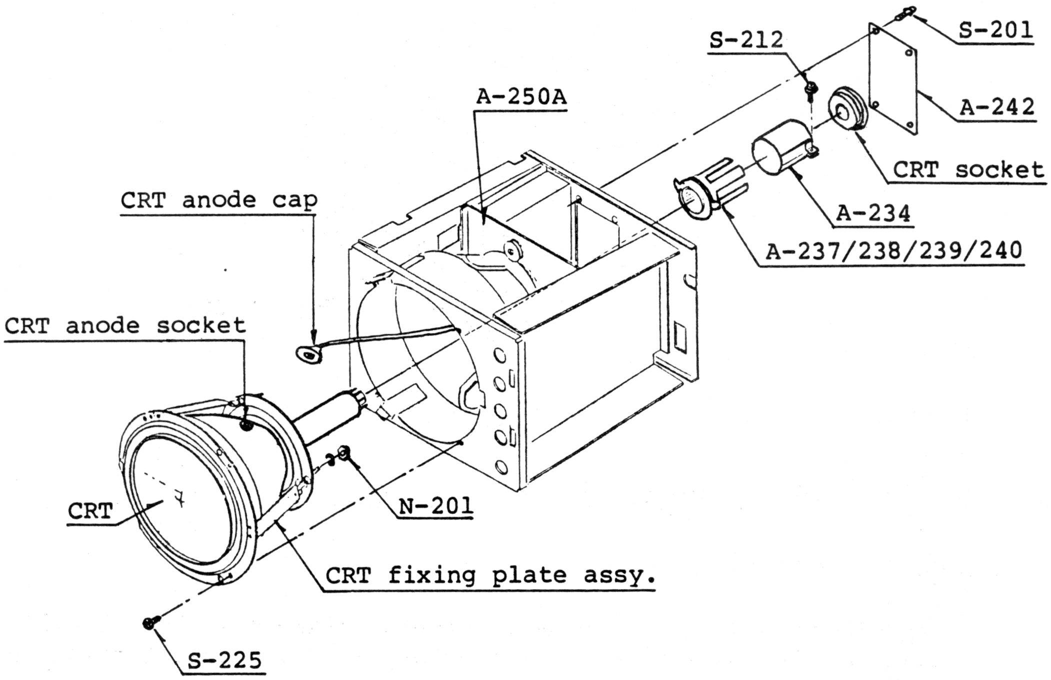

S-212
S-201
A-250A
A-242
CRT socket
CRT anode cap
A-234
A-237/238/239/240
CRT anode socket
CRT
N-201
CRT fixing plate assy.
S-225

Fig.3-3

NOTE: When the CRT is replaced, the position of the deflection table assembly A-250A should be readjusted. Refer to the next section.

3-4. Deflection Table Assembly A-250A

1) Remove the display cover A-203.

2) Remove the CRT, display main board and PT-4906 power supply board.

3) Unscrew four M4x10 washer head screws S-222, and the deflection table assembly A-250A comes out.

NOTE: When the CRT is replaced, the adjustment of the deflection table assembly position is required as follows. Move the deflection table assembly back and forth so that the assembly is placed in the nearest position to the CRT. Take care the assembly does not touch the CRT at any portion, then adjust the vertical position so that the CRT neck and the deflection coil are placed concentrically. If the deflection table assembly is placed backward excessively, the sweep trace is shortened or an abnormal sweep may occur.

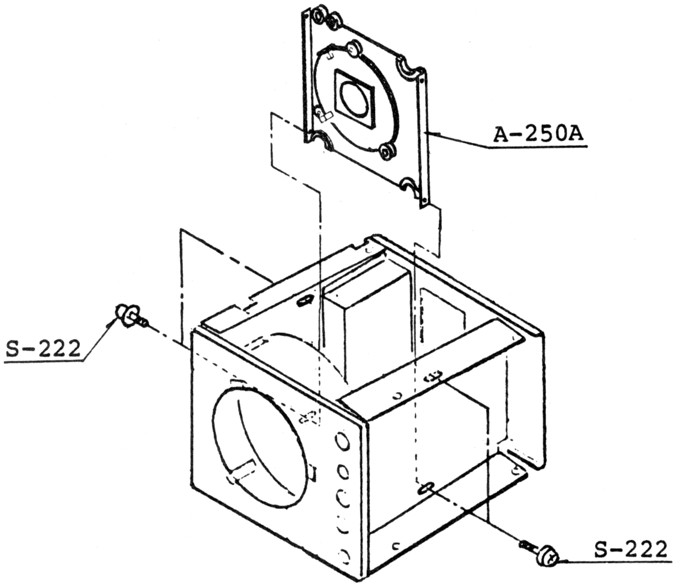


Fig.3-4

3-5. Deflection Coil L181/SR-4466 Slip Ring Board

1) Remove the CRT.

2) Remove the bearing A-254 by unscrewing M4x20 hex. bolt BT-251, and take out the deflection coil together with the coil turning gear A-258 and the slip ring board.

3) Unfasten four M3x6 washer head screws S-256, and unsolder two deflection coil lead wires from SR-4466 slip ring board.

4) Separate the deflection coil from the coil turning gear A-258 by unscrewing four M3x8 washer head screws S-251.

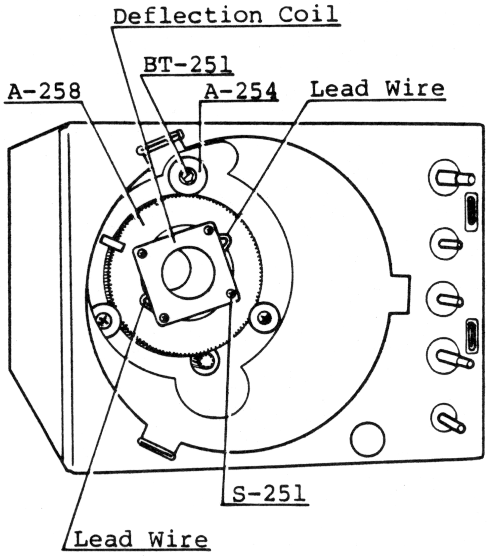

Deflection Coil
BT-251
A-258
A-254
Lead Wire
S-251
Lead Wire

Fig.3-5

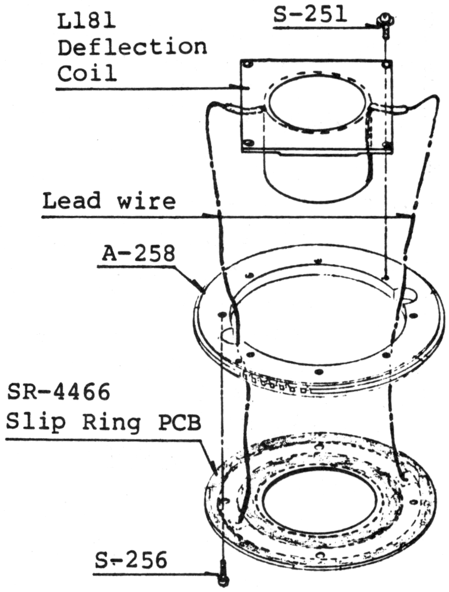
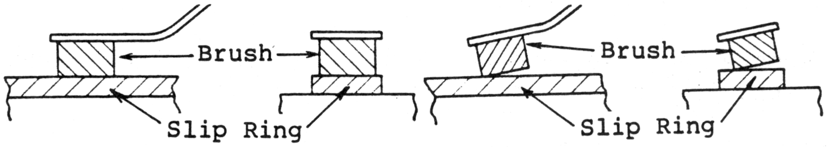

L181
Deflection
Coil
S-251
Lead wire
A-258
SR-4466
Slip Ring PCB
S-256

Fig.3-6

NOTE: 1. Do not lubricate the coil turning gear A-258. If the oil is put onto the gear, it spreads over the slip ring, where carbon powder from the brushes is mixed with the oil and acts as abrasive, causing wear of the slip ring in a short period.

2. When remounting the slip ring or brushes, adjust the contact between slip ring and brushes as shown below to prevent the slip ring from being quickly worn off by the brushes.


Brush
Slip Ring
Brush
Slip Ring

Good Contact

Bad Contact

Fig.3-7

3-6. Deflection Coil Drive Motor B1651

1) Take out the deflection table assembly A-250A.

2) Pull out the motor shield case(2) A-253, and unscrew two M3x10 washer head screws S-260, then, take out the motor together with the motor shield case(3) A-252. Take care not to lose nuts.

3) Remove the coil drive gear A-257 by loosening two M3x4 setscrews S-261.

4) Take out the motor from the motor shield case(3) A-252.

NOTE: Do not forget to put the motor shield cases on a new motor, otherwise the rugged range rings appear on the CRT due to magnetic field produced by the motor.

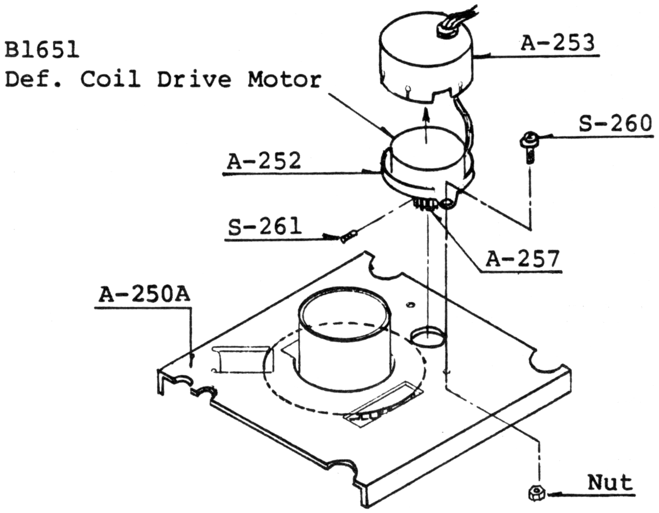


Fig.3-8

3-7. LP-4263, LP-4264 Lamp Boards

See Fig.3-9 on next page.

1) Remove the display cover A-203, and LP-4263 Lamp board is in sight at the rear of the front chassis.

2) Disconnect the plug P55 on the display main board.

3) Unscrew two M3x6 washer head screws S-216, and LP-4263 board comes out.

4) Remove the cursor panel A-217 referring to page 3-1, and three LP-4264 Lamp boards are in sight.

5) Disconnect the plug P56 on the display main board.

6) Unscrew M3x6 washer head screws S-218, S-208 and S-236, and LP-4264 boards come free.

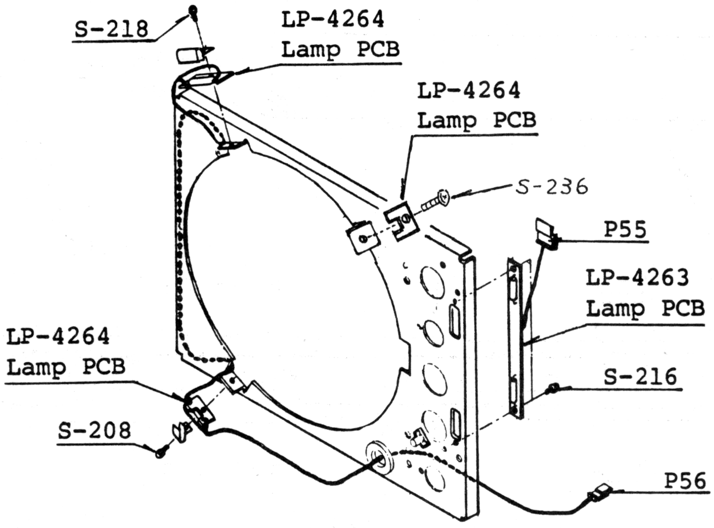

S-218
LP-4264
Lamp PCB
LP-4264
Lamp PCB
S-236
P55
LP-4263
Lamp PCB
LP-4264
Lamp PCB
S-216
S-208
P56

Fig.3-9

3-8. Contact Pin of Connector DP-1/DJ-1

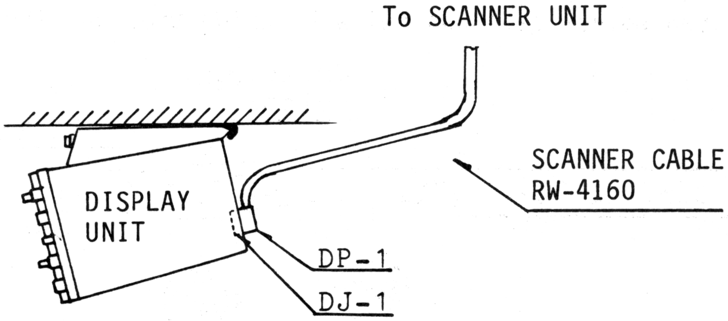

To SCANNER UNIT
SCANNER CABLE
RW-4160
DISPLAY
UNIT
DP-1
DJ-1

Fig.3-10

1) Open the connector plug DP-1.

2) Place the contact pin between the tips of the tool (MCP-KM), and push the tool until the contact pin with lead wire comes out.

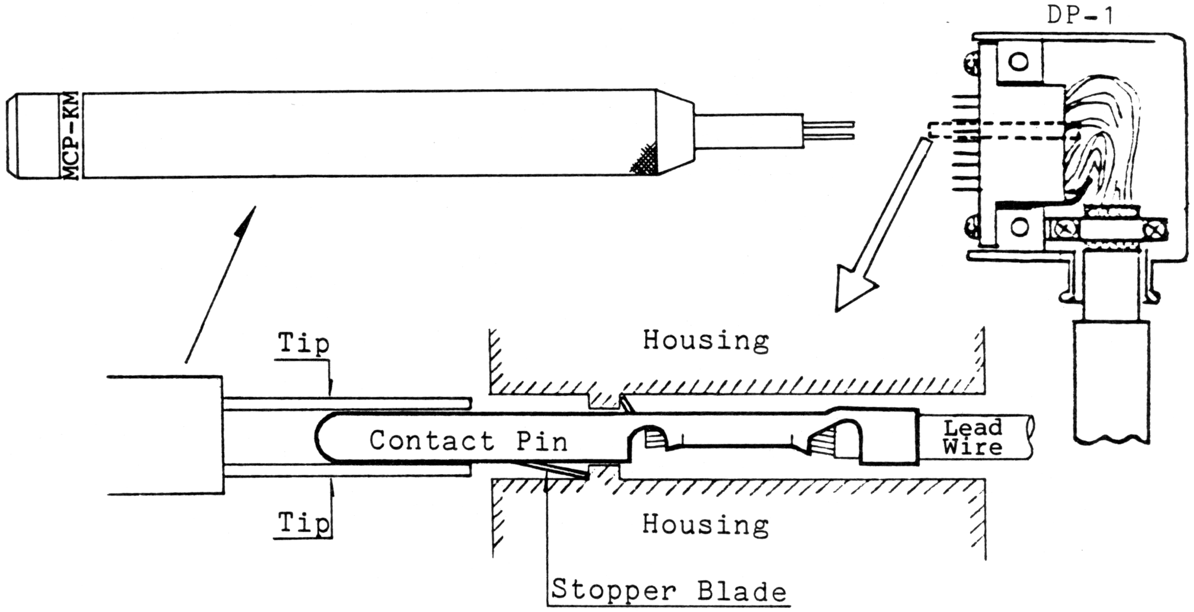

DP-1
MCP-KM
Tip
Housing
Contact Pin
Lead Wire
Tip
Housing
Stopper Blade

Fig.3-11

3) As for the jack DJ-1, do the same manner as above, but only the tool (MCP-KF) is different.

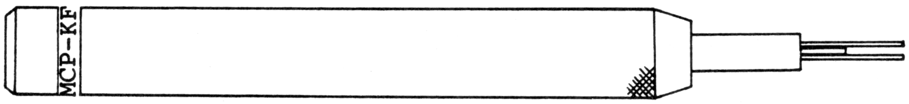


Fig.3-12

Note: When crimping the lead wire on the contact pin, crimp it at two points as shown below by using the tool (KP-300A).

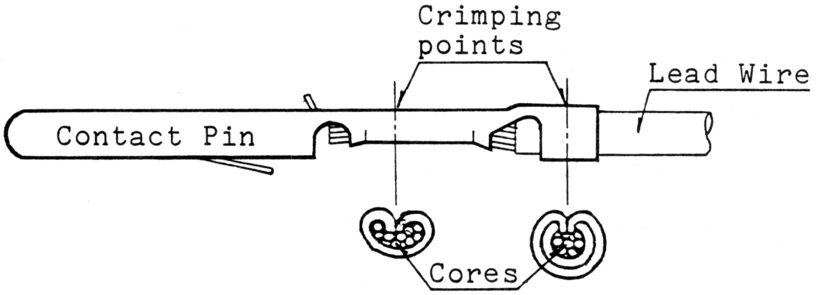

Crimping points
Lead Wire
Contact Pin
Cores

Fig.3-13

Special tools are

MCP-KM : for drawing out male contact pin of DP-1
MCP-KF : for drawing out female contact pin of DJ-1
KP-300A: for crimping contact pin of DP-1/DJ-1

3-9. Contact Pin of Connector Plug P51, P52, P60, etc.

1) The lead wire is locked to the connector housing with a stopper blade on the contact pin. To remove the lead from the housing, press the stopper blade with a screwdriver as shown below and pull the lead out.

2) Before putting the lead to the plug, raise the stopper blade to 30° with a knife edge.

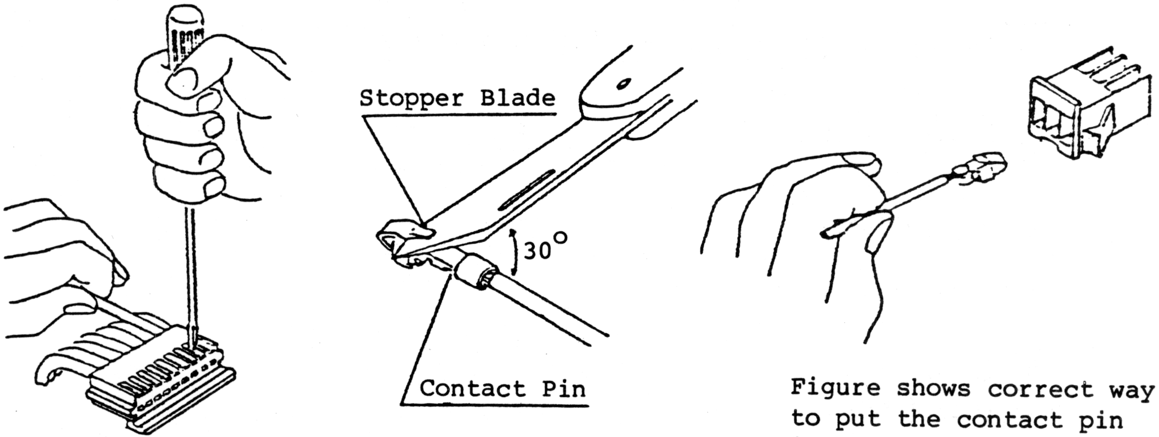


Figure shows correct way to put the contact pin into the housing.

Fig.3-14

CHAPTER 4. TECHNICAL DATA

The waveforms and voltages on principal points are shown on the circuit diagram. Refer to "CHAPTER 5. PARTS LOCATION" for the location of check points.

4-1. Characteristics of Major Electrical Components

Parts Name	Page
Cathode Ray Tube	4-2
CRT High Voltage Pack	4-3
Crystal	4-4
Diodes	4-5
Zener Diodes	4-5
Transistors	4-7
Light Emitting Diode	4-9
Voltage Reference Diode	4-9
Digital Integrated Circuits	4-10 & 4-11
Linear Integrated Circuits	4-12 & 4-13

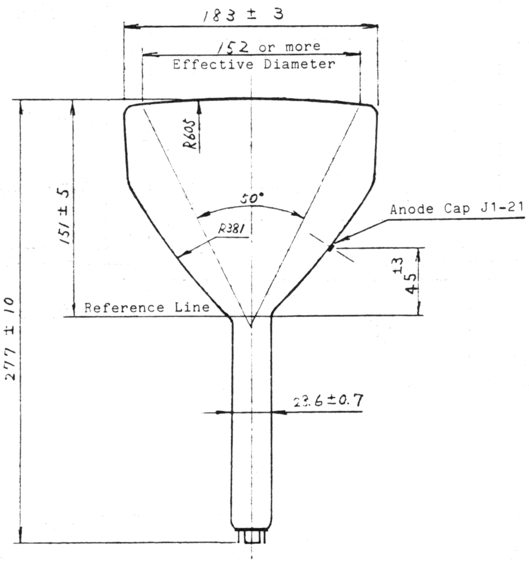
SPECIFICATIONS OF CATHODE RAY TUBE

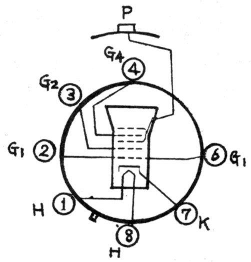
Type:	180SB7
Furuno Code No.:	000-103-600
Manufacturer:	Toshiba

Electrical Characteristics

Type of CRT:	Electromagnetic deflection, Electrostatic focus
Deflection Angle:	50 degrees
Structure:	Round, Metal back
Fluorescent Color:	White
Ratings:	

Item	Min.	Typ.	Max.	Unit
Heater Volt.	5.7	6.3	6.9	Vdc, ac
1st Grid Volt.	-180	-	0	Vdc
2nd Grid Volt.	250	400	550	Vdc
4th Grid Volt.	0	-	400	Vdc
Anode Volt.	7000	9000	11000	Vdc
Ambient Temp.	-20	-	80	°C


183 ± 3
152 or more
Effective Diameter
R605
50°
R381
Anode Cap J1-21
151 ± 5
277 ± 10
45^{13}
Reference Line
23.6 ±0.7


P
G4 ④
G2 ③
G1 ②
⑥ G1
H ①
⑦ K
⑧ H

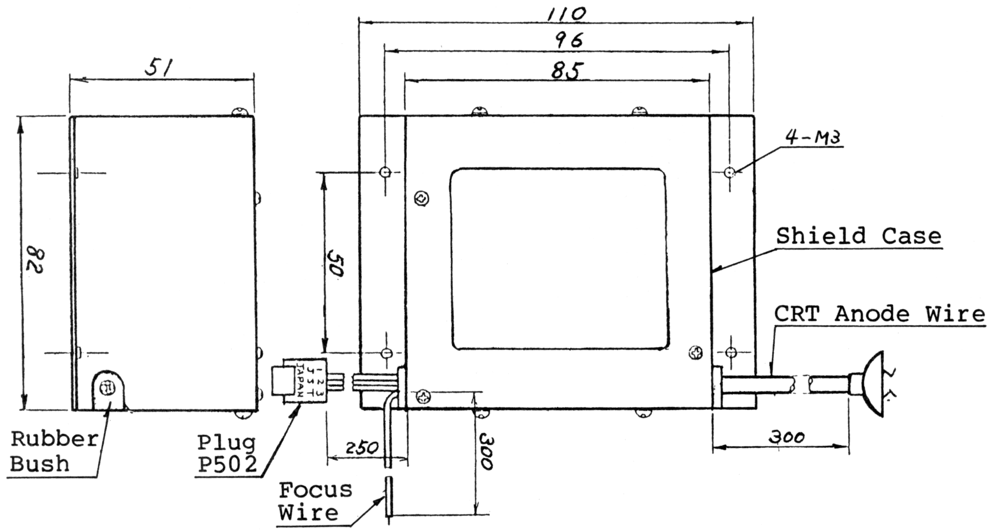
Pin Connection

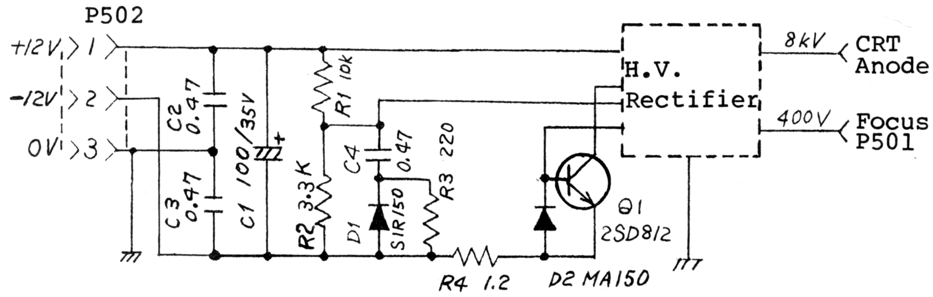
SPECIFICATIONS OF CRT HIGH VOLTAGE PACK

Type:	RU-3679-2
Furuno Code No.:	000-633-678
Manufacturer:	Matsushita

Electrical Characteristics

Item	Min.	Typ.	Max.	Unit
Input Voltage	-13.2	±12	+13.2	V
Input Current	-	±160 or less	-	mA
Output Voltage	-	8	9	kV
Output Current	-	70	77	uA
Focus Voltage	-	400	-	V
Output Deviation	-	2.5 or less	-	%
Ripple	-	0.2 or less	-	%
Output Deviation with Temp.	-	± 3 or less	-	%
Storage Temperature	-30	-	+70	°C
Operating Temperature	-20	-	+60	°C


51
82
110
96
85
4-M3
50
Shield Case
CRT Anode Wire
1 2 3
JST
JAPAN
Rubber Bush
Plug P502
250
300
Focus Wire
300

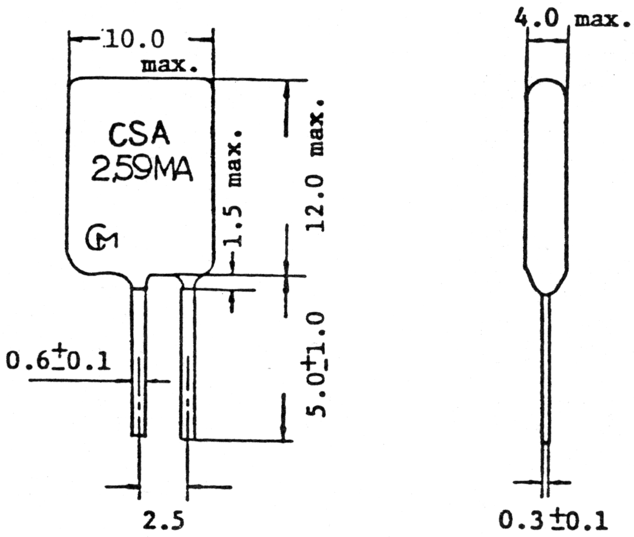

P502
+12V > 1
-12V > 2
0V > 3
C2 0.47
C3 0.47
C1 100/35V
R1 10k
R2 3.3K
C4 0.47
R3 220
D1 S1R150
R4 1.2
D2 MA150
Q1 2SD812
H.V. Rectifier
8kV
CRT Anode
400V
Focus P501

SPECIFICATIONS OF CRYSTAL

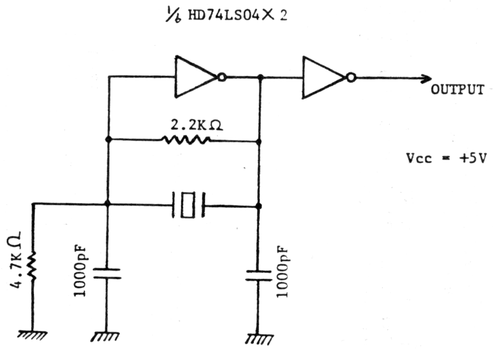
Type:	CSA2.59MA1
Furuno Code No.:	000-491-030
Manufacturer:	Murata

Electrical Characteristics

Oscillation Frequency:	2.59MHz ± 0.5%
Frequency Deviation:	Within ±0.3% under temperature range of -20°C to +80°C
Withstand Voltage:	DC50V max.


10.0 max.
CSA
2.59MA
1.5 max.
12.0 max.
0.6±0.1
5.0±1.0
2.5
4.0 max.
0.3±0.1

Outline


1/6 HD74LS04 × 2
OUTPUT
2.2KΩ
Vcc = +5V
4.7KΩ
1000pF
1000pF

OSC. Circuit

*** DIODE ***

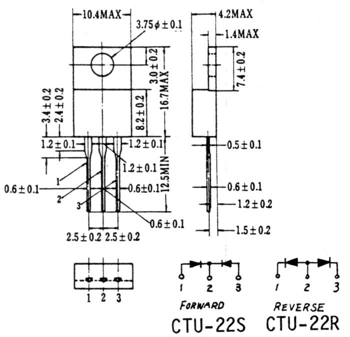
					ABSOLUTE MAX RATINGS AT 25°C						FORWARD (25°C)				REVERSE(25°C)			
TYPE	CODE NO.	MFR.	APPLI-CATION	CONST-RUCTION	VRM (V)	VR (V)	VI (V)	IFM (MA)	IO (MA)	IS (A)	MIN IF (MA)	VF (V)	MAX VF (V)	IF (A)	MAX IR (UA)	VR (V)	OUT-LINE	NOTE/SUBSTITUTE
CTU-22R	000132445	SKN	R	SI.D	200	140			1.1A	40			2	5	50	200	D-1	
CTU-22S	000132446	SKN	R	SI.D	200	140			1.1A	40			2	5	50	200	D-1	
MA26W0-B	000133739	MAT	TEMP	SI.D				30			3	1.25	1.35				D-2	
U06C	000135901	HTC	R	SI.D	200				2A	80			1.4	2			D-3	1S2596
V-19E	000136020	HTC	R	SI.D	400				1A	60			1.2	1	10	400	D-4	CATHODE:BLUE
1S1588	000112795	TOS	SW	SI.EP	35	30		360	120	0.5			1.3	0.1	0.5	30	D-5	
1S2095A	000113046	TOS	SW	SI.EP	75	70		750	250	1			0.65	1MA	0.1	50	D-5	
1S2462	000113090	TOS	D	SI.PL	220	200		300	100	0.8			1	0.1	1.2	200	D-5	
1 N60	000111090	TOS	D	GE.P	45	35		150	50	0.5	4	1			75	10	D-6	

NOTE: VRM=MAXIMUM REVERSE VOLTAGE, VR=MAX DC REVERSE VOLTAGE, VI=MAX AC INPUT VOLTAGE(RMS), IFM=MAX PEAK FORWARD CURRENT, IO=MAX AVERAGE DC OUTPUT CURRENT, IS=MAX FORWARD TRANSIT CURRENT, IF=FORWARD CURRENT, VF=FORWARD VOLTAGE, IR=REVERSE CURRENT, VR=REVERSE VOLTAGE.

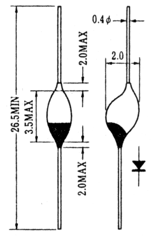
*** ZENER DIODE ***

					ABS MAX		ZENER VOLTAGE VZ				MAX DYNAMIC RESISTANCE		THERMAL COEFFICIENT OF VZ	REVERSE (25°C)			
TYPE	CODE NO.	MFR.	APPLI-CATION	CONST-RUCTION	P (MW)	IZ (MA)	MIN (V)	AVG (V)	MAX (V)	IZ (MA)	RZ (OHM)	IZ (MA)	(% /°C)	MAX IR (UA)	VR (V)	OUT-LINE	NOTE/SUBSTITUTE
RD10EB	000134816	NEC		SI.PL	400		9.4		10.6	20	10	20		2	7	D-5	
RD30EB	000134855	NEC		SI.EP	400		28.0		34.0	5	130	5		2	23	D-5	
RD33EB	000134860	NEC		SI.EP	400		31.0		37.0	5	160	5		2	25	D-5	
RD6.2EB1	000134833	NEC		SI.PL	400		5.8		7.0	20	20	20		5	3	D-5	
RD9.1EB1	000134835	NEC		SI.PL	400		8.5		9.6	20	10	20		2	6	D-5	
05Z5.1X	000110804	TOS		SI.PL	500	86	4.8	5.1	5.4	5	50	5	0.030	1	1	D-5	

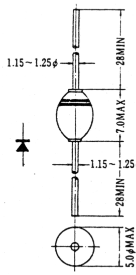
NOTE: P=MAXIMUM POWER DISSIPATION, IZ=ZENER CURRENT, IR=REVERSE CURRENT, VR=REVERSE VOLTAGE.


10.4MAX
3.75φ±0.1
4.2MAX
1.4MAX
3.0±0.2
16.7MAX
7.4±0.2
3.4±0.2
2.4±0.2
8.2±0.2
1.2±0.1
1.2±0.1
0.5±0.1
1.2±0.1
12.5MIN
0.6±0.1
0.6±0.1
0.6±0.1
1.2±0.2
0.6±0.1
1.5±0.2
2.5±0.2 2.5±0.2
1 2 3
FORWARD
REVERSE
CTU-22S
CTU-22R

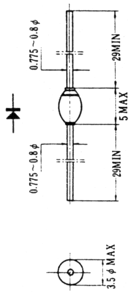
D-1


0.4φ
2.0
2.0MAX
26.5MIN
3.5MAX
2.0MAX

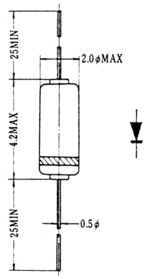
D-2


1.15~1.25φ
28MIN
7.0MAX
1.15~1.25φ
28MIN
5.0φMAX

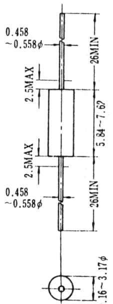
D-3


0.775~0.8φ
29MIN
5MAX
0.775~0.8φ
29MIN
3.5φMAX

D-4


25MIN
2.0φMAX
4.2MAX
25MIN
0.5φ

D-5


0.458
~0.558φ
26MIN
2.5MAX
5.84~7.62
2.5MAX
0.458
~0.558φ
26MIN
2.16~3.17φ

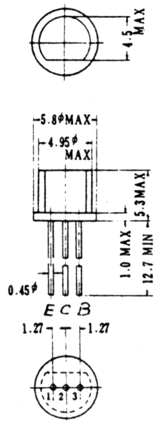
D-6

*** TRANSISTOR ***

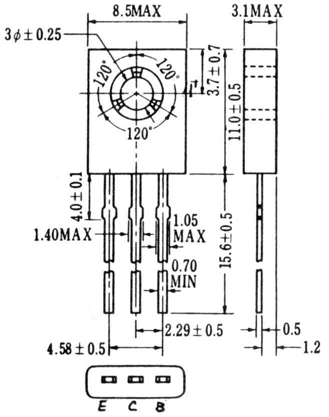
TYPE	CODE NO.	MFR.	APPLI-CATION	CONST-RUCTION	ABSOLUTE MAX RATINGS AT 25°C					CHARACTERISTICS(25°C)				TO NO.	OUT-LINE	NOTE/SUBSTITUTE
					VCBO (V)	VEBO (V)	IC (MA)	PC (MW)	TJ (°C)	VCE (V)	IC (MA)	HFE	FT (MHZ)			
2SA1020-Y	000118050	TOS	PA.SW	SI.E	-50	-5	-2A	900	150	-2	-500	70-240	100		TR-8	
2SA467GTMO	000116930	TOS	RF	SI.EP	-40	-5	-400	400	125	-1	-100	70-140	100		TR-1	COMPLEMENT.2SC367GTM-O
2SA495GTMO	000116992	TOS	RF	SI.E	-50	-5	-150	400	125	-1	-10	70-140	100		TR-1	
2SA743A-C	000117466	HTC	RF.PA	SI.E	-50	-4	-1A	8W	150	-4	-50	120	120		TR-2	
2SA778K	000117520	HTC	RF	SI.TD	-150	-5	-50	200	125	-3	-15	100	50		TR-4	
2SB434-Y	000120871	TOS	PA	SI.EME	-50	-5	-3A	25W*	150	-5	-500	120-240	10		TR-5	* AT TC=25°C
2SC1569	000125117	TOS	PA	SI.TP	300	5	150	1.5W	150	10	50	40-170	100		TR-5	
2SC2334-6K	000126152	NEC	SW	SI	150	7	7A	1.5W	150			100-200			TR-6	
2SC2837-0	000126301	SKN		SI	150	5	10A	100W	150			50-100	70		TR-7	
2SC367GTMO	000123552	TOS	RF.CONV	SI.EP	40	5	400	400	125	1	100	70-140	120		TR-1	COMPLEMENT.2SA467GTM-O
2SC752GTMO	000124129	TOS	RF	SI.EP	40	5	200	400	125	1	100	70-140	400		TR-1	
2SC945	000124420	NEC	RF.AF	SI.E	60	5	100	250	125	6	1	200	250		TR-3	CONPLEMENT 2SA733

NOTE: VCBO=COLLECTOR-BASE VOLTAGE (EMITTER OPEN), VEBO=EMITTER-BASE VOLTAGE (COLLECTOR OPEN), IC=COLLECTOR CURRENT,
PC=POWER DISSIPATION, TJ=JUNCTION TEMPERATURE, VCE=COLLECTOR-EMITTER VOLTAGE, IC=COLLECTOR CURRENT,
HFE=STATIC FORWARD CURRENT TRANSFER RATIO, FT=TRANSITION FREQUENCY.

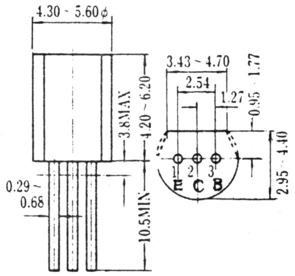
MANUFACTURER(MFR.): FUJ=FUJITSU, HTC=HITACHI, IRJ=INTERNATIONAL RECTIFIER (JAPAN), MAT=MATSUSHITA, MOT=MOTOROLA, MTB=MITSUBISHI,
NEC=NIPPON ELECTRIC, NJR=NEW JAPAN RADIO, OKI=OKI ELECTRIC, ORG=ORIGIN ELECTRIC, SKN=SANKEN ELECTRIC,
SND=SHINDENGEN ELECTRIC, SON=SONY, STL=STANLEY ELECTRIC, SYO=SANYO, TOS=TOSHIBA, FJD=FUJI ELECTRIC


4.5 MAX
5.8ϕMAX
4.95ϕ MAX
5.3MAX
1.0 MAX
12.7 MIN
0.45ϕ
E C B
1.27
1.27
1 2 3

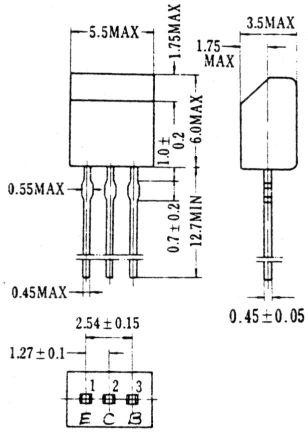
TR-1


8.5MAX
3.1MAX
3ϕ±0.25
120°
120°
120°
3.7±0.7
11.0±0.5
4.0±0.1
1.40MAX
1.05 MAX
0.70 MIN
15.6±0.5
2.29±0.5
4.58±0.5
0.5
1.2
E C B

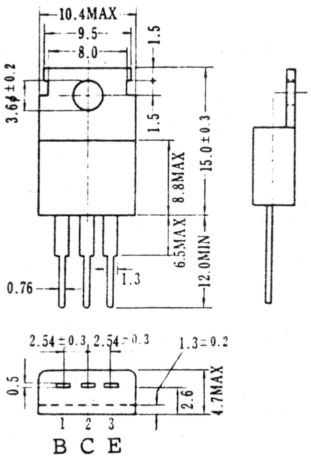
TR-2


4.30 ~ 5.60ϕ
3.8MAX
4.20 ~ 6.20
0.29 ~ 0.68
10.5MIN
3.43 ~ 4.70
2.54
1.27
0.95 · 1.77
1 2 3
E C B
2.95 · 4.40

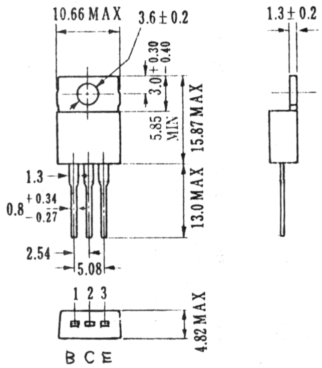
TR-3


5.5MAX
1.75MAX
3.5MAX
1.75 MAX
6.0MAX
1.0±0.2
0.55MAX
0.7±0.2
12.7MIN
0.45MAX
0.45±0.05
2.54±0.15
1.27±0.1
1 2 3
E C B

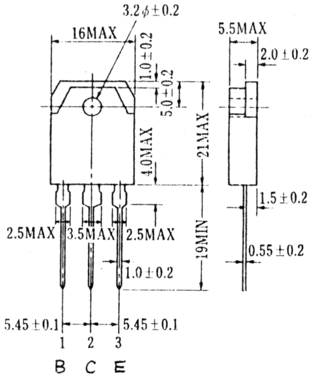
TR-4


10.4MAX
9.5
8.0
1.5
3.6ϕ±0.2
1.5
15.0±0.3
8.8MAX
6.5MAX
12.0MIN
0.76
1.3
2.54±0.3
2.54±0.3
1.3±0.2
0.5
2.6
4.7MAX
1 2 3
B C E

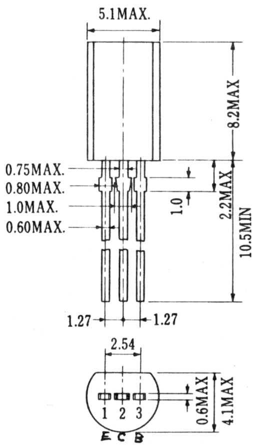
TR-5


10.66 MAX
3.6±0.2
1.3±0.2
3.0 +0.30 −0.40
5.85 MIN
15.87 MAX
1.3
0.8 +0.34 −0.27
13.0 MAX
2.54
5.08
1 2 3
4.82 MAX
B C E

TR-6


3.2ϕ±0.2
16MAX
1.0±0.2
5.5MAX
2.0±0.2
5.0±0.2
4.0MAX
21MAX
1.5±0.2
2.5MAX
3.5MAX
2.5MAX
19MIN
0.55±0.2
1.0±0.2
5.45±0.1
5.45±0.1
1 2 3
B C E

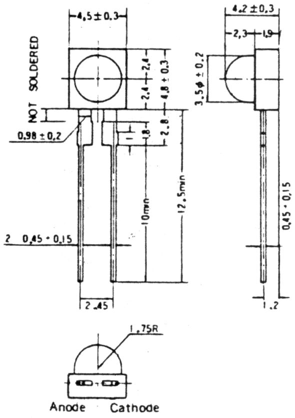
TR-7


5.1MAX.
8.2MAX
0.75MAX.
0.80MAX.
1.0MAX.
0.60MAX.
1.0
2.2MAX
10.5MIN
1.27
1.27
2.54
1 2 3
0.6MAX
4.1MAX
E C B

TR-8

SPECIFICATIONS OF LED

Type: LN35BP
Furuno Code No.: 000-133-609
Manufacturer: Matsushita


4,5±0.3
4.2±0.3
2,3
1,9
NOT SOLDERED
2,4
2,4
4,8±0.3
3,5ϕ±0.2
0,98±0,2
1,8
2,8
10min
12,5min
2 0,45 · 0,15
0,45 · 0,15
2.45
1.2
1.75R
Anode
Cathode

Electrical Characteristics

Absolute Maximum Ratings (Ta = 25°C)
Reverse Voltage: 4V
Forward Current (IF): 30mA
Power Dissipation: 90mW
Operating Temperature: -25 to +85°C

Electro-optical Characteristics (Ta = 25°C)
Luminous Intensity: 0.7mcd (min.) at IF=20mA
Forward Voltage: 2.8V (max.) at IF=20mA

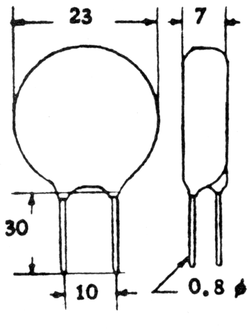
Color: Blue

SPECIFICATIONS OF VOLTAGE REFERENCE DIODE

Type: ERZ-15D3K221
Furuno Code No.: 000-132-669

Electrical Characteristics

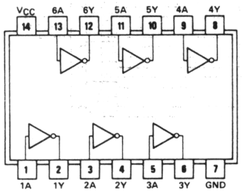
Maximum Power: 1.5W
Zener Voltage (Vx): 220V ± 10%
Voltage Deviation Ratio (V10/V1): 1.08 max. (V10:Vx at 10mA, V1:Vx at 1mA)
Operating Temperature: -20 to +120°C


23
7
30
10
0.8 ϕ

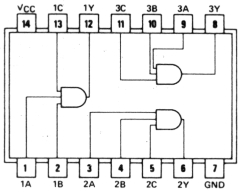
SPECIFICATIONS OF DIGITAL IC (TTL Low-power Schottky)

Type	Code No.	Manuf.	Function	Substitute
HD74LS04P	000-162-404	Hitachi	Hex. Inverters	SN74LS04
HD74LS11P	000-162-411	Hitachi	Tri 3 Input AND	SN74LS11
HD74LS26P	000-162-426	Hitachi	Quad 2 Input O.C.NAND Buffers	SN74LS26
HD74LS27P	000-162-427	Hitachi	Tri 3 Input NOR	SN74LS27
HD74LS73P	000-162-473	Hitachi	Dual J-K Flip-Flops with Clear	SN74LS73
HD74LS132P	000-162-485	Hitachi	Quad 2 Input NAND Schmitt Trig.	SN74LS132
HD74LS148P	000-162-492	Hitachi	8 to 3 Priority Encoder	SN74LS148
HD74LS151P	000-162-510	Hitachi	8 to 1 Data Selector	SN74LS151
HD74LS161P	000-162-516	Hitachi	Synchro. Presettable 4-Bit Counter	SN74LS161A
HD74LS221P	000-162-530	Hitachi	Dual Single Shot	SN74LS221
HD74LS393P	000-162-580	Hitachi	Dual 4-Bit Binary Counters	SN74LS393

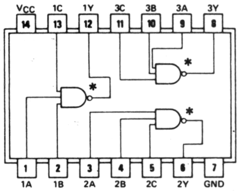
Logic Diagram of TTL Digital IC


VCC 6A 6Y 5A 5Y 4A 4Y
14 13 12 11 10 9 8
1 2 3 4 5 6 7
1A 1Y 2A 2Y 3A 3Y GND

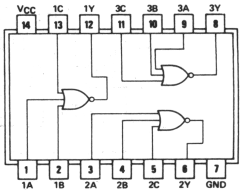
HD74LS04P


VCC 1C 1Y 3C 3B 3A 3Y
14 13 12 11 10 9 8
1 2 3 4 5 6 7
1A 1B 2A 2B 2C 2Y GND

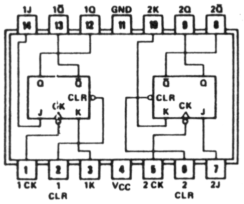
HD74LS11P


VCC 1C 1Y 3C 3B 3A 3Y
14 13 12 11 10 9 8
*
*
*
1 2 3 4 5 6 7
1A 1B 2A 2B 2C 2Y GND

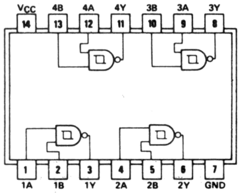
HD74LS26P


VCC 1C 1Y 3C 3B 3A 3Y
14 13 12 11 10 9 8
1 2 3 4 5 6 7
1A 1B 2A 2B 2C 2Y GND

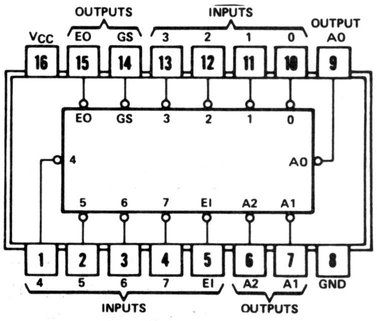
HD74LS27P


1J 1Q̄ 1Q GND 2K 2Q 2Q̄
14 13 12 11 10 9 8
Q Q̄ CLR CK J K
1 2 3 4 5 6 7
1CK 1 CLR 1K VCC 2CK 2 CLR 2J

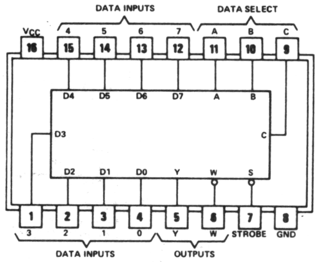
HD74LS73P


VCC 4B 4A 4Y 3B 3A 3Y
14 13 12 11 10 9 8
1 2 3 4 5 6 7
1A 1B 1Y 2A 2B 2Y GND

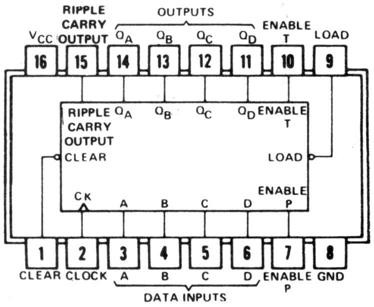
HD74LS132P


OUTPUTS
INPUTS
OUTPUT
VCC EO GS 3 2 1 0 A0
16 15 14 13 12 11 10 9
EO GS 3 2 1 0
4 A0
5 6 7 EI A2 A1
1 2 3 4 5 6 7 8
4 5 6 7 EI A2 A1 GND
INPUTS
OUTPUTS

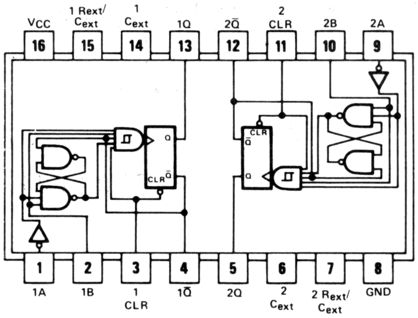
HD74LS148P


DATA INPUTS
DATA SELECT
VCC 4 5 6 7 A B C
16 15 14 13 12 11 10 9
D4 D5 D6 D7 A B
D3 C
D2 D1 D0 Y W S
1 2 3 4 5 6 7 8
3 2 1 0 Y W STROBE GND
DATA INPUTS
OUTPUTS

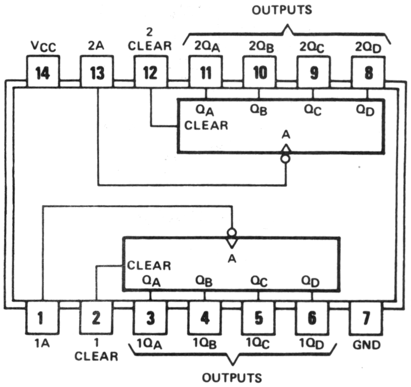
HD74LS151P


RIPPLE CARRY OUTPUT
OUTPUTS
ENABLE T
LOAD
VCC QA QB QC QD
16 15 14 13 12 11 10 9
RIPPLE CARRY OUTPUT QA QB QC QD ENABLE T
CLEAR
LOAD
ENABLE P
CK A B C D
1 2 3 4 5 6 7 8
CLEAR CLOCK A B C D ENABLE P GND
DATA INPUTS

HD74LS161P


VCC 1 Rext/Cext 1 Cext 1Q 2Q̄ 2 CLR 2B 2A
16 15 14 13 12 11 10 9
CLR Q̄ Q
1 2 3 4 5 6 7 8
1A 1B 1 CLR 1Q̄ 2Q 2 Cext 2 Rext/Cext GND

HD74LS221P

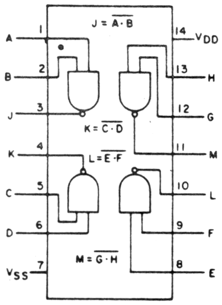

OUTPUTS
VCC 2A 2 CLEAR 2QA 2QB 2QC 2QD
14 13 12 11 10 9 8
QA QB QC QD
CLEAR
A
A
CLEAR
QA QB QC QD
1 2 3 4 5 6 7
1A 1 CLEAR 1QA 1QB 1QC 1QD GND
OUTPUTS

HD74LS393P

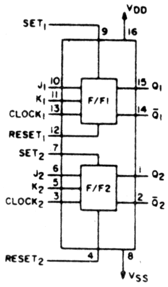
SPECIFICATIONS OF DIGITAL IC (C-MOS)

Type	Code No.	Manuf.	Function	EIA/JEDEC STD.
TC4011BP	000-163-245	Toshiba	Quad 2-input NAND	4011B
TC4027BP	000-163-251	Toshiba	Dual JK-FFs with S/R	4027B
TC4051BP	000-163-257	Toshiba	Single 8-ch. Multiplexer	4051B
MC14538BCP	000-170-016	Motorola	Dual Monostable Multi.	4538B
MC14541BCP	000-170-018	Motorola	Programmable Timer	4541B

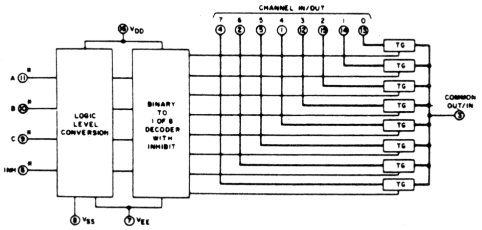
Logic Diagram of C-MOS Digital IC


J = $\overline{A \cdot B}$
K = $\overline{C \cdot D}$
L = $\overline{E \cdot F}$
M = $\overline{G \cdot H}$
A
B
J
K
C
D
V_{SS}
V_{DD}
H
G
M
L
F
E
1
2
3
4
5
6
7
14
13
12
11
10
9
8

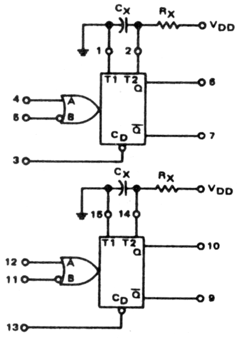
TC4011BP


V_{DD}
SET_1
9
16
J_1
K_1
$CLOCK_1$
$RESET_1$
SET_2
J_2
K_2
$CLOCK_2$
$RESET_2$
10
11
13
12
7
6
5
3
4
8
F/F1
F/F2
15
Q_1
14
$\bar{Q}_1$
1
Q_2
2
$\bar{Q}_2$
V_{SS}

TC4027BP

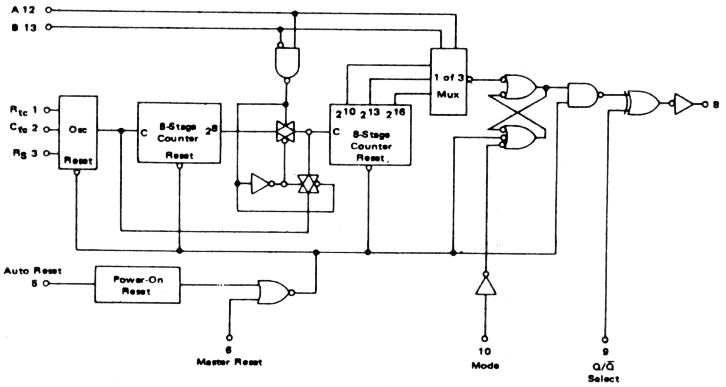

CHANNEL IN/OUT
7
6
5
4
3
2
1
0
4
2
5
1
12
15
14
13
16 V_{DD}
A 11
B 10
C 9
INH 6
LOGIC LEVEL CONVERSION
BINARY TO 1 OF 8 DECODER WITH INHIBIT
TG
COMMON OUT/IN
3
8 V_{SS}
7 V_{EE}

TC4051BP


C_X
R_X
V_{DD}
1
2
4
5
A
B
T1
T2
Q
C_D
$\bar{Q}$
6
7
3
15
14
12
11
10
9
13

R_X and C_X are external components.
V_{DD} = Pin 16
V_{SS} = Pin 8

MC14538BCP

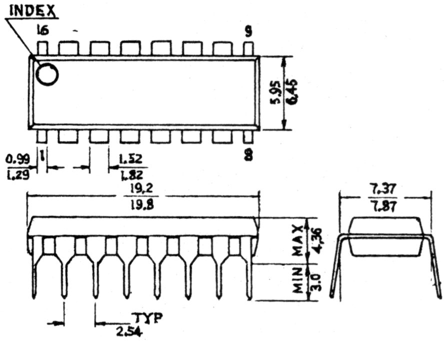

A 12
B 13
R_{tc} 1
C_{tc} 2
R_S 3
Osc
Reset
C
8-Stage Counter
2^8
Reset
2^{10}
2^{13}
2^{16}
C
8-Stage Counter
Reset
1 of 3 Mux
8
Auto Reset
5
Power-On Reset
6
Master Reset
10
Mode
9
Q/$\bar{Q}$ Select

V_{DD} = Pin 14
V_{SS} = Pin 7

MC14541BCP

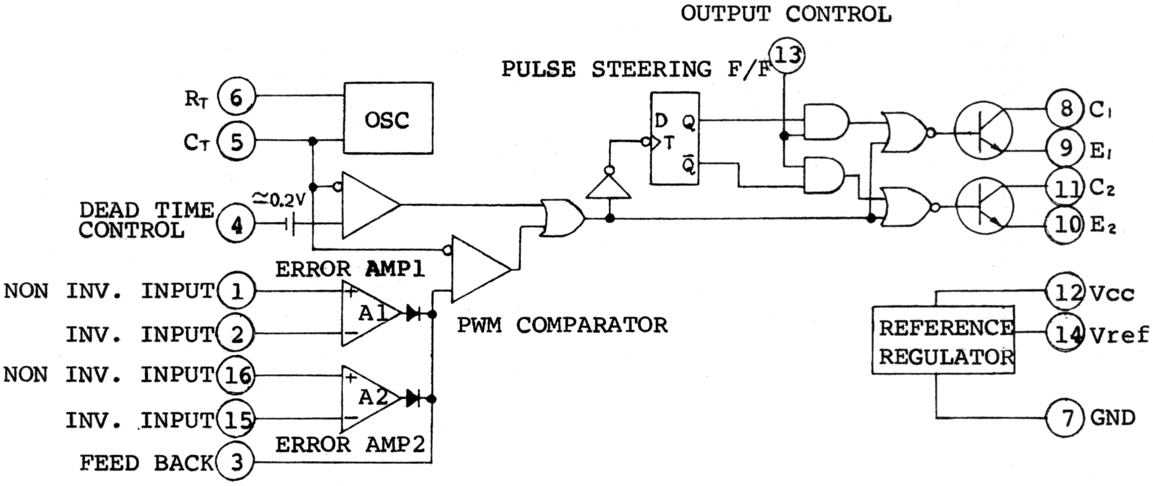
SPECIFICATIONS OF LINEAR IC (Switching Regulator Control Circuit)

Type:	MB3759M
Furuno Code No.:	000-157-500
Manufacturer:	Fujitsu


INDEX
16
9
1
8
5.95
6.45
0.99
1.29
1.52
1.82
19.2
19.8
7.37
7.87
MAX 4.36
MIN 3.0
TYP
2.54

Electrical Characteristics

Parameter	Min.	Typ.	Max.	Unit
Input Voltage (Vcc)	7	15	40	V
Collector Output Voltage (Vce)			40	V
Collector Output Current (Ice)			200	mA
Amp. Input Voltage (Vin)	-0.3		Vcc-2	V
FB Term. Input Current (Isink)			0.3	mA
Output Current (Iref)			10	mA
Timing Resistance (Rt)	1.8	30	500	kohm
Timing Capacitance (Ct)	470	1000	10^6	pF
Osc. Frequency (fosc)	1	40	300	kHz
Operating Temperature (Top)	0	25	70	°C


OUTPUT CONTROL
PULSE STEERING F/F
13
D Q
T
Q̄
R_T 6
C_T 5
OSC
DEAD TIME CONTROL 4
≃0.2V
ERROR AMP1
NON INV. INPUT 1
INV. INPUT 2
NON INV. INPUT 16
INV. INPUT 15
FEED BACK 3
ERROR AMP2
A1
A2
+
−
PWM COMPARATOR
8 C_1
9 E_1
11 C_2
10 E_2
12 Vcc
14 Vref
7 GND
REFERENCE REGULATOR

BLOCK DIAGRAM

SPECIFICATIONS OF LINEAR IC (OP Amp.)

Type	TL081CP	μPC157C
Code Number	000-168-486	000-161-031
Manufacturer	T.I.	NEC
Substitute		LM301

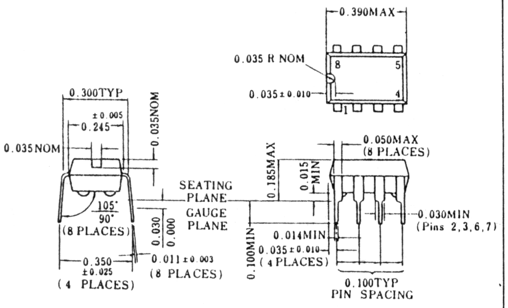
Maximum Ratings

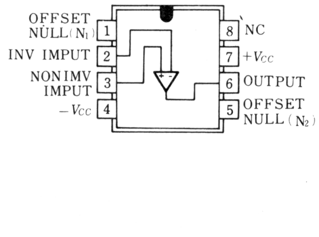
Supply Voltage (Vcc)	±18V	±18V
Power Dissipation (PD)	625 to 680mW	500mW
Operating Temp.(Top)	0 to 70°C	-15 to +80°C
Input Voltage (VI)	-15V to +15V	-15 to +15V

Characteristics

Large Signal Voltage Gain (Av)		109dB
Slew Rate (SR)	13v/us	0.5v/us

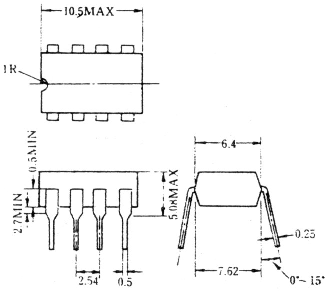
TL081CP

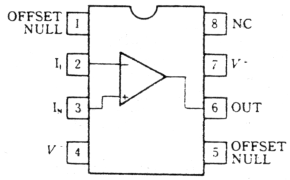

0.390MAX
0.035 R NOM
8
5
4
1
0.035±0.010
0.300TYP
±0.005
0.245
0.035NOM
0.035NOM
SEATING PLANE
GAUGE PLANE
105°
90°
(8 PLACES)
0.030
0.000
0.350
±0.025
(4 PLACES)
0.011±0.003
(8 PLACES)
0.185MAX
0.015 MIN
0.050MAX
(8 PLACES)
0.030MIN
(Pins 2,3,6,7)
0.014MIN
0.100MIN
0.035±0.010
(4 PLACES)
0.100TYP
PIN SPACING


OFFSET NULL (N1) 1
INV IMPUT 2
NONIMV IMPUT 3
−Vcc 4
8 NC
7 +Vcc
6 OUTPUT
5 OFFSET NULL (N2)

Unit in inch

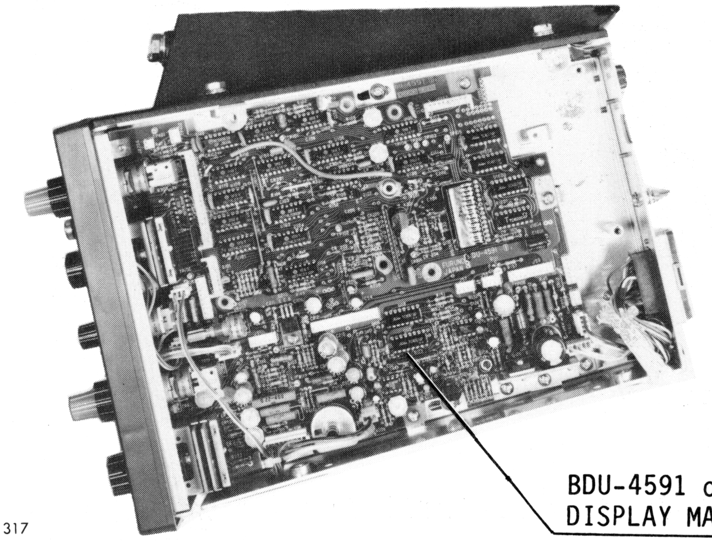
μPC157C


10.5MAX
1R
0.5MIN
2.7MIN
5.08MAX
2.54
0.5
6.4
7.62
0.25
0°~15°


OFFSET NULL 1
I1 2
I2 3
V− 4
8 NC
7 V+
6 OUT
5 OFFSET NULL

Unit in mm

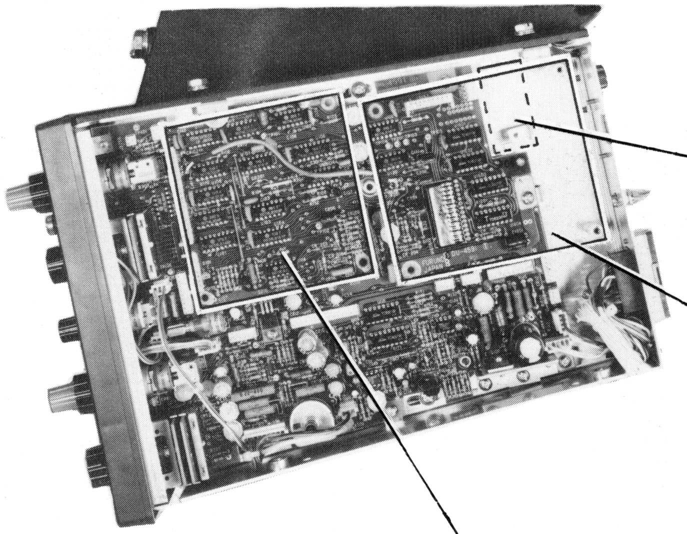
CHAPTER 5. PARTS LOCATION



BDU-4591 or CDU-4591
DISPLAY MAIN BOARD

N Photo No.1317

Fig.5-1 Display Unit Right-side View



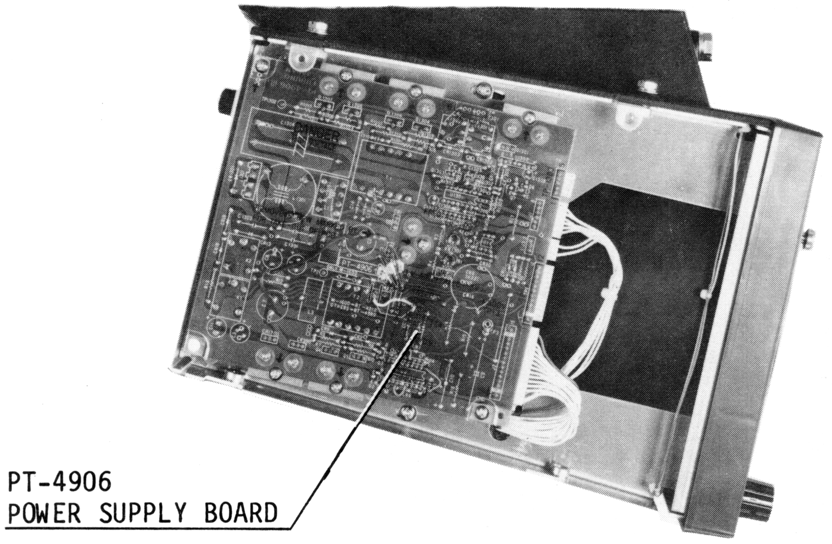
CG-4257 (Option)
8MHz CLOCK BOARD

EVRM-3692 (Option)
EVRM BOARD

IR-3695 (Option)
INTERFERENCE REJECTOR BOARD

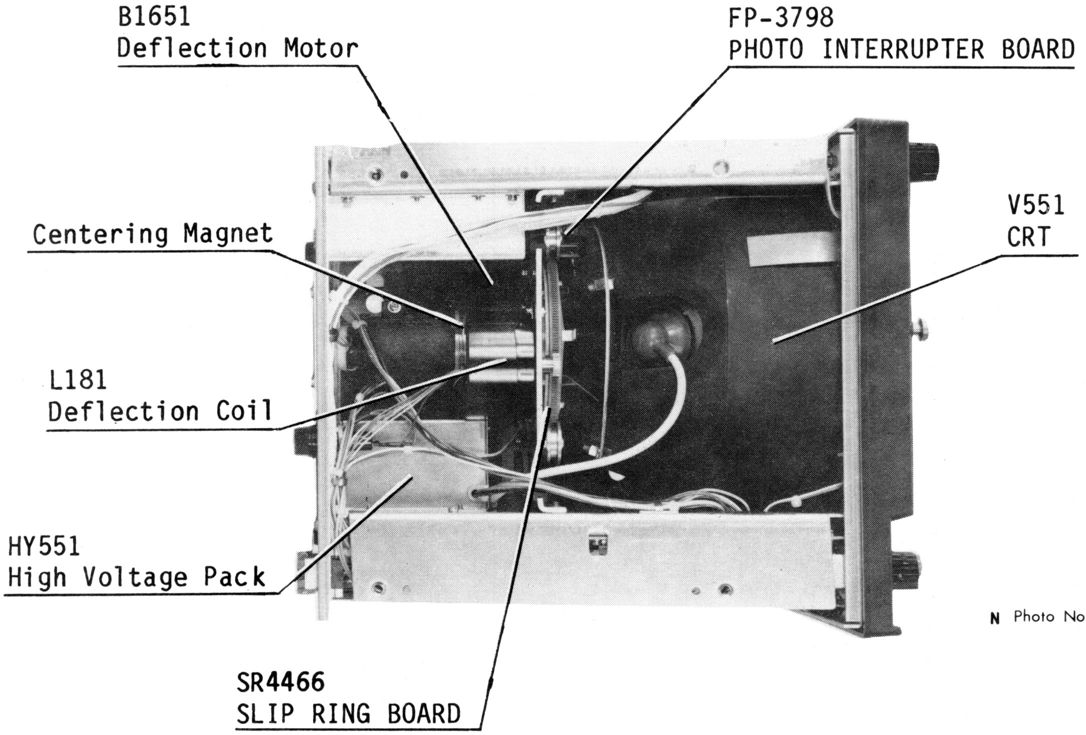
N Photo No.1317

Fig.5-2 Location of Optional Boards


PT-4906
POWER SUPPLY BOARD

N Photo No.1318

Fig.5-3 Display Unit Left-side View


B1651
Deflection Motor
FP-3798
PHOTO INTERRUPTER BOARD
Centering Magnet
V551
CRT
L181
Deflection Coil
HY551
High Voltage Pack
SR4466
SLIP RING BOARD

N Photo No.1319

Fig.5-4 Display Unit Top View

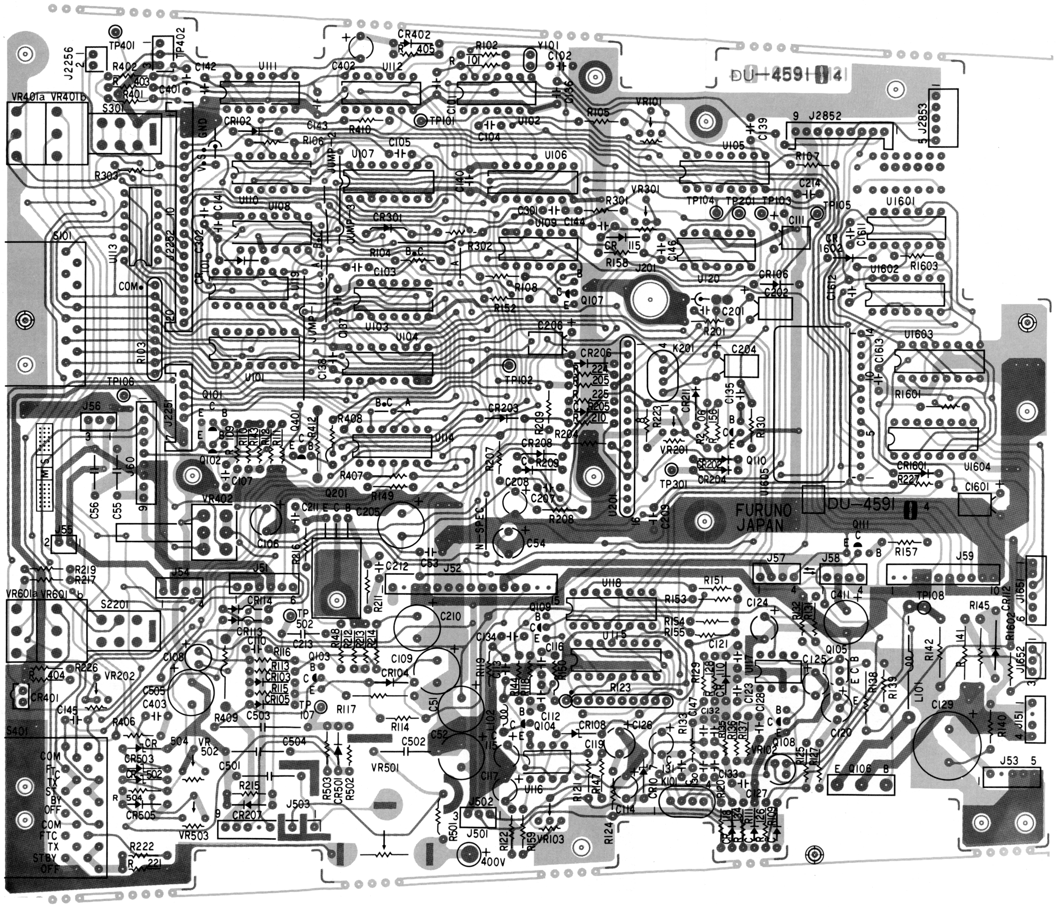


Fig.5-5 DISPLAY MAIN BOARD (BDU-4591 for MODEL 2400 & FR-240 MARK-Ⅲ, CDU-4591 for FR-360 MARK-Ⅱ)

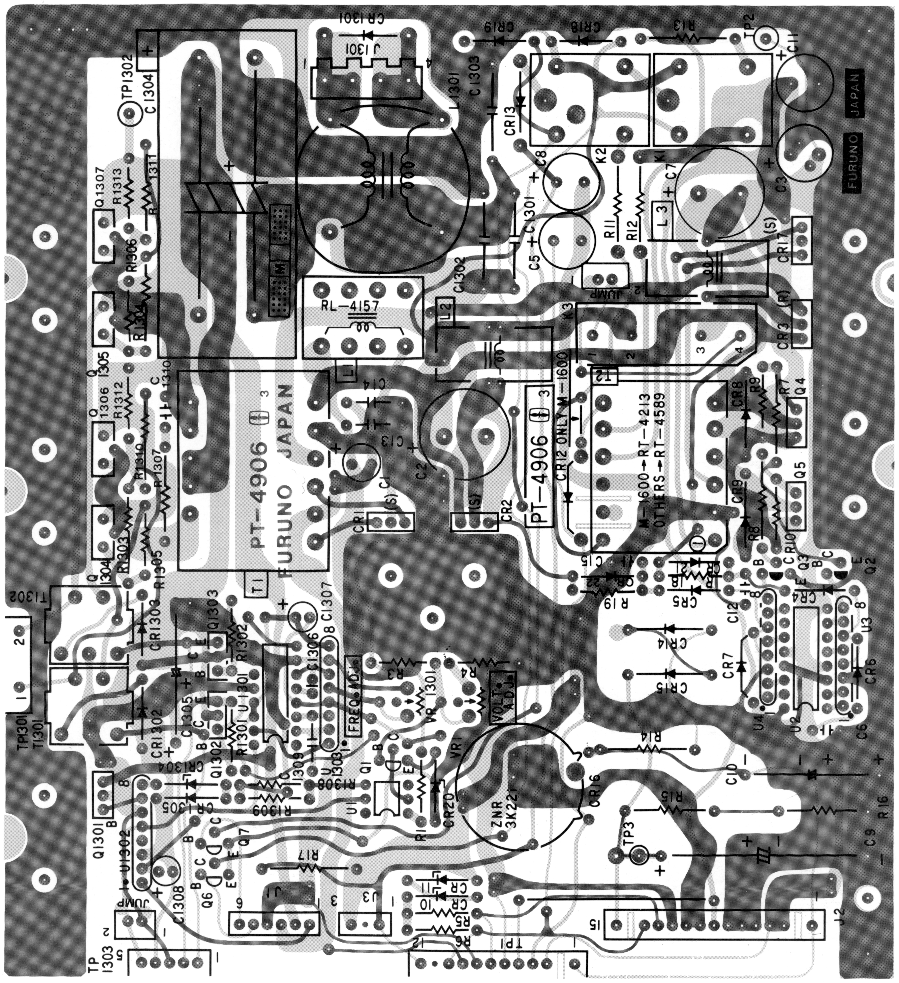

PT-4906
FURUNO JAPAN
PT-4906
CR12 ONLY M-1600
M-1600→RT-4213
OTHERS→RT-4589
RL-4157
FREQ. ADJ.
VOLT. ADJ.
ZNR 3K221
TP1301
T1301
T1302
TP1302
TP1303
TP1
TP2
TP3
Q1301
Q1302
Q1303
Q1304
Q1305
Q1306
Q1307
U1301
U1302
C1301
C1302
C1303
C1304
C1305
C1306
C1307
C1308
C1310
CR1301
CR1302
CR1303
CR1304
CR1305
R1301
R1302
R1303
R1304
R1305
R1306
R1307
R1308
R1309
R1310
R1311
R1312
R1313
VR1301
VR1
J1301
L1301
L1
L2
L3
T1
K1
K2
K3
JUMP
J1
J2
J3
U1
U2
U3
U4
Q1
Q2
Q3
Q4
Q5
Q6
Q7
C1
C2
C3
C5
C6
C7
C8
C9
C10
C11
C12
C13
C14
C15
CR1
CR2
CR3
CR4
CR5
CR6
CR7
CR8
CR9
CR10
CR11
CR13
CR14
CR15
CR16
CR17
CR18
CR19
CR20
R1
R3
R4
R5
R6
R7
R8
R9
R11
R12
R13
R14
R15
R16
R17
R19
FURUNO
JAPAN

Fig.5-6 POWER SUPPLY BOARD PT-4906

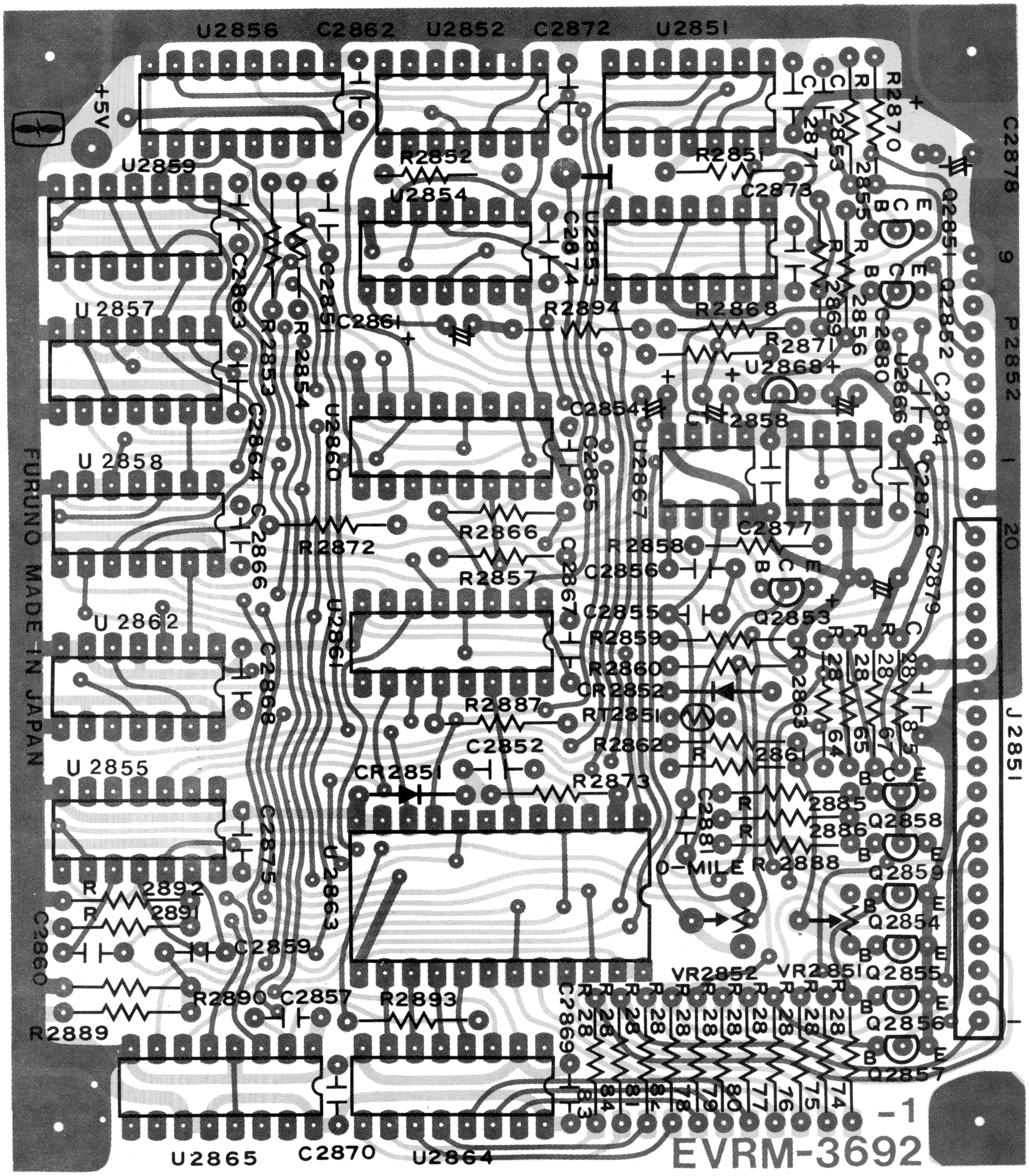

U2856
C2862
U2852
C2872
U2851
+5V
U2859
R2852
U2854
R2851
C2873
R2870
R2855
C2878
Q2851
9
Q2852
P2852
1
20
J2851
U2857
C2863
R2853
R2854
C2861
U2853
C2874
R2894
R2868
R2871
R2869
R2856
C2880
U2866
U2868
C2884
C2854
C2858
U2858
C2864
U2860
C2865
U2867
C2876
C2877
C2879
R2872
R2866
R2857
R2858
C2856
C2867
FURUNO MADE IN JAPAN
U2862
C2866
U2861
C2855
Q2853
R2859
R2860
CR2852
R2863
R2864
R2865
R2867
R2885
C2868
R2887
RT2851
R2862
R2861
C2852
U2855
CR2851
R2873
C2881
R2885
Q2858
R2886
0-MILE
R2888
Q2859
C2875
U2863
R2892
R2891
Q2854
C2860
C2859
VR2852
VR2851
Q2855
R2890
C2857
R2893
C2869
Q2856
R2889
R2883
R2884
R2881
R2882
R2878
R2879
R2880
R2877
R2876
R2875
R2874
Q2857
-1
EVRM-3692
U2865
C2870
U2864

Fig.5-7 EVRM BOARD EVRM-3692 (Option)

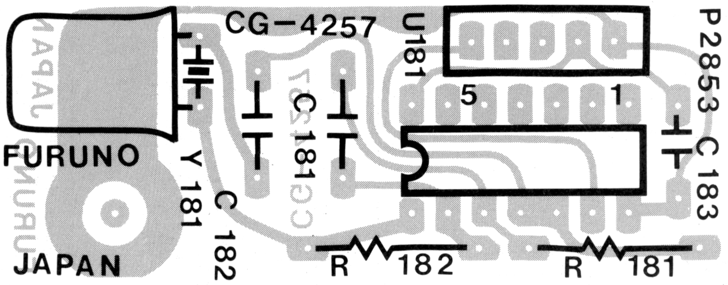

CG-4257
U181
P2853
5
1
C183
C181
FURUNO
Y181
C182
JAPAN
R182
R181

Fig.5-8 8MHz CLOCK BOARD CG-4257 (Option)

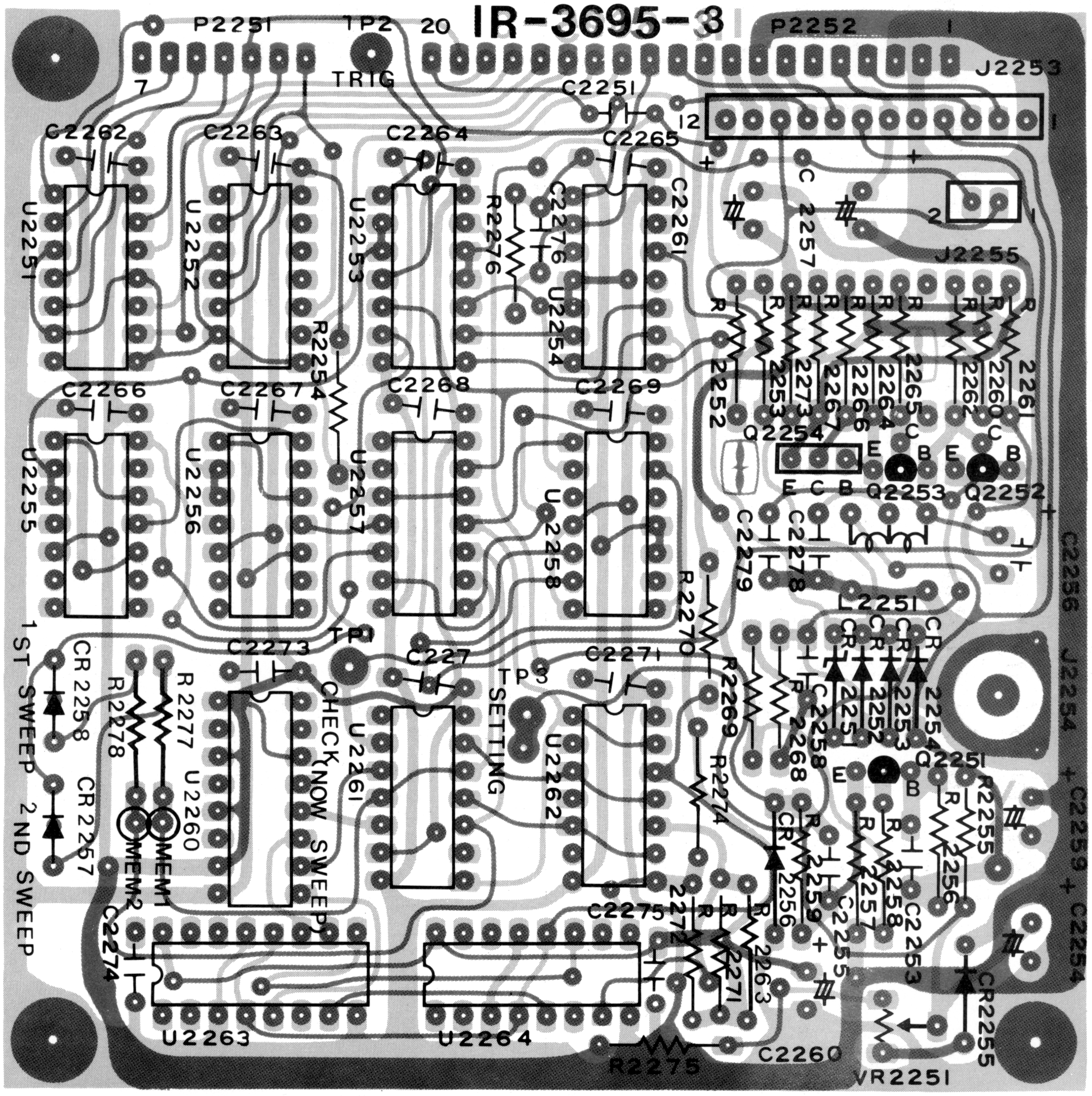

IR-3695-3
P2251
TP2
20
P2252
1
J2253
7
TRIG
1
C2251
12
1
C2262
C2263
C2264
C2265
C2261
U2251
U2252
U2253
R2276
C2276
U2254
C
2257
2
1
J2255
R
2252
2253
2273
2267
2266
2264
2265
2262
2260
2261
R2254
C2266
C2267
C2268
C2269
U2255
U2256
U2257
U2258
Q2254
E C B
E
B
C
Q2253
Q2252
C2279
C2278
C2256
R2270
L2251
CR
2251
2252
2253
2254
1ST SWEEP
CR2258
R2278
R2277
C2273
TP1
CHECK
NOW SWEEP
U2261
C227
TP3
SETTING
C2271
U2262
R2269
R2268
C2258
J2254
Q2251
E
B
R2274
R2255
C2259
2ND SWEEP
CR2257
U2260
MEM1
MEM2
C2274
CR2256
R2259
R2257
R2258
C2255
C2253
R2256
C2275
2272
2271
2263
C2254
CR2255
U2263
U2264
R2275
C2260
VR2251

Fig.5-9 INTERFERENCE REJECTOR BOARD IR-3695 (Option)

SYMBOL 記号	TYPE 型名	SPECIFICATIONS 規格	CODE NO. コード番号	REMARKS 備考
	PRINTED CIRCUIT BOARD ﾌﾟﾘﾝﾄｷﾊﾞﾝ			
	BDU4591, FR-240 MK-3	MODEL-2400	003-114-570	MODEL2400/FR240M3
	CDU4591	FR-360 MK-2	003-114-790	FR360M2
	PT4906, MODEL-2400	FR-240M3/360M2	003-114-630	
	LP-4264		003-114-280	
	LP-4263		003-114-270	
	SR-4466		000-634-466	
	FP-3798		003-114-250	
	MOTOR	ﾓｰﾀｰ		
B 1651	SM40-4806-C	12-3-3966-1	000-431-452	
	CAPACITOR	ｺﾝﾃﾞﾝｻｰ		
C 1	ECE-A1CS101	100UF 16V	000-201-427	
C 2	ECE-A1CF102	1000UF 16V	000-201-620	
C 3	ECE-A1CF471	470UF 16V	000-201-610	
C 5	ECE-A-160V-10U	10UF 160V	000-200-312	
C 6	DD109E103P50V02	0.01UF 50V	000-253-436	
C 7	ECE-A1HF221	220UF 50V	000-201-630	
C 8	ECE-A-160V-10U	10UF 160V	000-200-312	
C 9	ECE-B-450V-3R3	3.3UF 450V	000-202-404	
C 10	ECE-B-450V-1	1UF 450V	000-202-400	
C 11	ECE-A1AF102	1000UF 10V	000-201-640	
C 12	ECQ-M1H102KZ	1000PF 50V	000-260-360	
C 13	MD2-2A-104M	0.1UF 100V	000-262-369	
C 14	MD2-2A-104M	0.1UF 100V	000-262-369	
C 15	ECQ-M1H102KZ	1000PF 50V	000-260-360	
C 51	ECE-A1CS221	220UF 16V	000-201-428	
C 52	ECE-A1CS221	220UF 16V	000-201-428	
C 53	DD109E103P50V02	0.01UF 50V	000-253-436	
C 54	ECEA1AS221	220UF 10V	000-201-415	
C 55	MD2-2A-104M	0.1UF 100V	000-262-369	
C 56	MD2-2A-104M	0.1UF 100V	000-262-369	
C 101	ECQ-P1102GZ	0.001UF, 100WV	000-261-870	
C 102	ECQ-P1102GZ	0.001UF, 100WV	000-261-870	
C 103	ECQ-M1H102KZ	1000PF 50V	000-260-360	
C 104	RPE110CH151J50	150PF 50V	000-251-705	
C 105	ECQ-M1H102KZ	1000PF 50V	000-260-360	
C 106	ECE-A1CS101	100UF 16V	000-201-427	
C 107	RPE110CH331J50	330PF, 50V	000-251-702	
C 108	ECE-A-160V-1U	1UF 160V	000-200-300	
C 109	ECE-A-160V-10U	10UF 160V	000-200-312	
C 110	PRE110CH471J50	470PF 50V	000-251-703	
C 111	ECE-A1CS100	10UF 16V	000-201-423	
C 112	RPE110CH101J50	100PF, 50V	000-251-700	
C 113	ECQ-P1332GZ	3300PF 100V	000-261-379	
C 114	ECE-A1CS100	10UF 16V	000-201-423	
C 115	ECE-A1CS100	10UF 16V	000-201-423	
C 116	RPE110CH101J50	100PF, 50V	000-251-700	
C 117	ECE-A1CS100	10UF 16V	000-201-423	
C 119	ECE-A1CS101	100UF 16V	000-201-427	
C 120	ECE-A1CS101	100UF 16V	000-201-427	
C 121	ECE-F1H220JC2	22PF 50V	000-256-905	
C 123	RPE110CH151J50	150PF 50V	000-251-705	
C 124	ECE-A1CS100	10UF 16V	000-201-423	
C 125	ECE-A1CS100	10UF 16V	000-201-423	
C 126	ECEA1CS330	33UF 16V	000-201-425	
C 127	RPE110CH101J50	100PF, 50V	000-251-700	
C 128	RPE110CH121J50	120PF, 50WV	000-251-706	
C 129	ECE-A2CS101	100UF 160V	000-201-505	
C 130	ECE-F1H040CC	4PF 50VDC	000-255-204	
C 131	ECC-F1H330JC	33PF 50VDC	000-255-222	
C 132	ECC-F1H150JC2	15PF, 50V	000-256-902	
C 133	ECE-F1H070DC	7PF 50VDC	000-255-207	
C 134	RPE110CH101J50	100PF, 50V	000-251-700	
C 135	RPE110CH101J50	100PF, 50V	000-251-700	
C 136	DD610BC204Z	0.2UF 12WV	000-252-260	
C 137	DD610BC204Z	0.2UF 12WV	000-252-260	
C 138	DD610BC204Z	0.2UF 12WV	000-252-260	
C 139	DD610BC204Z	0.2UF 12WV	000-252-260	
C 140	DD610BC204Z	0.2UF 12WV	000-252-260	
C 141	DD610BC204Z	0.2UF 12WV	000-252-260	
C 142	DD109E103P50V02	0.01UF 50V	000-253-436	
C 143	DD610BC204Z	0.2UF 12WV	000-252-260	
C 144	ECQ-M1H102KZ	1000PF 50V	000-260-360	
C 145	DD109E103P50V02	0.01UF 50V	000-253-436	
C 146	DD610BC204Z	0.2UF 12WV	000-252-260	
C 147	ECE-F1H070DC	7PF 50VDC	000-255-207	
C 201	RPE110CH151J50	150PF 50V	000-251-705	
C 202	ECE-A1CS100	10UF 16V	000-201-423	
C 204	ECE-A1CS101	100UF 16V	000-201-427	
C 205	ECE-A1CS221	220UF 16V	000-201-428	
C 206	ECE-A1CS100	10UF 16V	000-201-423	
C 207	ECQ-M-1H563KZ	0.056UF 50WV	000-260-379	
C 208	ECE-A1HS010	1UF 50V	000-201-459	
C 209	ECQ-M1H473KZ	47000PF 50V	000-260-385	
C 210	ECE-A-160V-10U	10UF 160V	000-200-312	
C 211	PRE110CH471J50	470PF 50V	000-251-703	
C 212	RPE110CH101J50	100PF, 50V	000-251-700	
C 213	MD2-2A-104M	0.1UF 100V	000-262-369	
C 214	ECQ-M1H102KZ	1000PF 50V	000-260-360	
C 301	ECE-F1H180JC	18PF 50VDC	000-255-216	
C 302	RPE110CH151J50	150PF 50V	000-251-705	
C 401	ECQ-M1H103KZ	0.01UF 50V	000-260-370	
C 402	ECEA1AS101	100UF 10V	000-201-414	
C 403	DD610BC204Z	0.2UF 12WV	000-252-260	
C 411	ECEA1HS221	220UF 50V	000-201-468	
C 501	MD-2-2G-104M	0.1UF 400WV	000-262-313	
C 502	MD-2-2G-104M	0.1UF 400WV	000-262-313	
C 503	MD-2-2G-224M	0.22UF 400WV	000-262-315	
C 504	MD-2-2G-104M	0.1UF 400WV	000-262-313	
C 505	ECE-A-160V-10U	10UF 160V	000-200-312	
C 1301	MD2-2A-105M	1UF 100V	000-262-371	
C 1302	MD2-2A-105M	1UF 100V	000-262-371	
C 1303	MD2-2A-105M	1UF 100V	000-262-371	
C 1304	FTE1G102	1000UF 40V	000-218-010	
C 1305	ECEB1CS471	470UF 16V	000-203-300	
C 1306	RPE111CH821J50	820PF 50V	000-251-722	
C 1307	ECE-A1CS100	10UF 16V	000-201-423	
C 1308	ECEA1AS101	100UF 10V	000-201-414	
C 1309	ECQ-M-1H154KZ	0.15UF 50WV	000-260-384	
C 1310	ECQ-M-1-102KZ	1000PF, 100WV	000-260-073	
C 1351	MD2-2A-225M	2.2UF 100V	000-262-370	
C 1352	MD2-2A-225M	2.2UF 100V	000-262-370	
C 1353	MD2-2A-225M	2.2UF 100V	000-262-370	
C 1354	ECK-F1H473ZF	0.047UF 50V	000-255-151	
C 1355	ECK-F1H473ZF	0.047UF 50V	000-255-151	
C 1356	ECEB1HS102	1000UF 50V	000-203-334	
C 1601	ECE-A1CS101	100UF 16V	000-201-427	
C 1611	DD109E103P50V02	0.01UF 50V	000-253-436	
C 1612	DD109E103P50V02	0.01UF 50V	000-253-436	
C 1613	DD109E103P50V02	0.01UF 50V	000-253-436	
	DIODE	ﾀﾞｲｵｰﾄﾞ		
CR 1	CTU-22S		000-132-446	
CR 2	CTG-22S		000-132-441	
CR 3	CTG-22R		000-132-440	
CR 4	1S2095A		000-113-046	
CR 5	1S2095A		000-113-046	
CR 6	1S1588		000-112-795	
CR 7	1S1588		000-112-795	
CR 8	V19E		000-136-020	
CR 9	V19E		000-136-020	
CR 10	RD30EB		000-134-855	
CR 11	RD30EB		000-134-855	
CR 12	V19E		000-136-020	
CR 13	V19E		000-136-020	
CR 14	DFG1B15		000-136-017	
CR 15	DFG1B15		000-136-017	
CR 16	ERZ15D3K221		000-132-669	
CR 17	CTU-22S		000-132-446	
CR 18	1S1588		000-112-795	
CR 19	1S1588		000-112-795	
CR 20	RD-6.2EB1		000-134-833	
CR 21	1S1588		000-112-795	
CR 22	1S1588		000-112-795	
CR 101	1S1588		000-112-795	
CR 102	1S1588		000-112-795	
CR 103	1S1588		000-112-795	
CR 104	1S2462		000-113-090	
CR 105	1S2462		000-113-090	
CR 106	1S1588		000-112-795	
CR 107	RD10EB		000-134-816	
CR 108	05Z5.1X		000-110-804	
CR 109	1S1588		000-112-795	
CR 110	1S1588		000-112-795	
CR 111	1S1588		000-112-795	
CR 112	V19E		000-136-020	
CR 113	1S1588		000-112-795	
CR 114	1S1588		000-112-795	
CR 115	1S1588		000-112-795	
CR 118	1S1588		000-112-795	
CR 202	1S1588		000-112-795	
CR 203	1S1588		000-112-795	
CR 204	1S1588		000-112-795	
CR 205	1N60		000-111-090	
CR 206	**MA26W0-B**		**000-133-739**	
CR 207	1S2462		000-113-090	
CR 208	1S1588		000-112-795	
CR 209	1S1588		000-112-795	
CR 211	1S1588		000-112-795	
CR 301	1S1588		000-112-795	
CR 401	LN35BP		000-133-609	
CR 402	1S1588		000-112-795	
CR 501	1S2462		000-113-090	
CR 502	RD33EB		000-134-860	
CR 503	RD33EB		000-134-860	
CR 504	RD33EB		000-134-860	
CR 505	1S2462		000-113-090	

NOTE:
備 考:

FURUNO

MODEL 2400/FR-360MK-Ⅱ/FR-240MK-Ⅲ

DISPLAY UNIT
指　示　部

REF. DWG. No.
参照図番　C3255-007-A

SYMBOL 記号	TYPE 型名	SPECIFICATIONS 規格	CODE NO. コード番号	REMARKS 備考
CR 1301	U06C		000-135-901	
CR 1302	1S1588		000-112-795	
CR 1303	1S1588		000-112-795	
CR 1304	RD-9.1EB1		000-134-835	
CR 1305	MA26W0-B		000-133-739	
CR 1601	1S1588		000-112-795	
CR 1602	1S1588		000-112-795	
	CONNECTOR	ｺﾈｸﾀｰ		
DJ 1	MCP-24F02		000-500-161	HOUSING
	MCP-24S		000-500-164	FIXTURE
	MCP-F102R		000-500-163	CONTACT 20PCS
	CONNECTOR	ｺﾈｸﾀ		
DP 1	MCP-24M02		000-500-160	HOUSING
	MCP-24WS2		000-500-150	FIXTURE
	MCP-M102R		000-500-162	CONTACT 20PCS
	LAMP	ﾗﾝﾌﾟ		
DS 51	T3.8C-8V-60MA	13-3-4442	000-540-180	
DS 52	T3.8C-8V-60MA	13-3-4442	000-540-180	
DS 53	T3.8C-8V-60MA	13-3-4442	000-540-180	
DS 54	T3.8C-8V-60MA	13-3-4442	000-540-180	
DS 55	T3.8C-8V-60MA	13-3-4442	000-540-180	
	CARBON BRUSH	ｶｰﾎﾞﾝ ﾌﾞﾗｼ		
E 181	12-3-3249-2		000-633-249	
E 182	12-3-3249-2		000-633-249	
	FUSE	ﾋｭｰｽﾞ		
F 1	F-1065, 0.5A	6.4MM DIA	000-547-004	
F 1351	F-7161, 10A	6.4MM DIA	000-547-015	
F 1352	F-7161, 1A	6.4MM DIA	000-547-006	
	HIGH VOLTAGE PACK	ｺｳｱﾂﾊﾟｯｸ		
HY 551	RU-3679-2	13-3-3679-3	000-633-678	
	JACK	ｼﾞｬｯｸ		
J 1	BS6P-SHF-1AA		000-505-569	
J 2	BS15P-SHF-1AA	15P	000-505-576	
J 3	BS3P-SHF-1AA	3P	000-505-566	
J 51	B6P-SHF-1AA	6P	000-505-554	
J 52	B15P-SHF-1AA	15P	000-505-561	
J 53	B5P-SHF-1AA	5P	000-505-553	
J 54	B4P-SHF-1AA	4P	000-505-552	
J 55	B2P-SHF-1AA	2P	000-505-550	
J 56	B3P-SHF-1AA	3P	000-505-551	
J 57	B4P-SHF-1AA	4P	000-505-552	
J 58	B4P-SHF-1AA	4P	000-505-552	
J 59	B10P-SHF-1AA	10P	000-505-558	
J 60	B9P-SHF-1AA	9P	000-505-557	
J 151	B4P-SHF-1AA	4P	000-505-552	
J 201	CN-3561 1P (F)		000-510-559	
J 501	RT-01T-1.3B		000-505-352	
J 502	B3P-SHF-1AA	3P	000-505-551	
J 503	B9P-SHF-1AA	9P	000-505-557	
J 1301	RTB-1.5-4F		000-505-349	
J 1351	16R-2A		000-500-347	
J 1651	B6P-SHF-1AA	6P	000-505-554	
J 1652	B3P-SHF-1AA	3P	000-505-551	
J 2251	F7P-HVQ		000-505-407	
J 2252	F20P-HVQ		000-505-420	
J 2256	B2P-SHF-1AA	2P	000-505-550	
J 2852	F9P-HVQ		000-505-409	
J 2853	F5P-SHVQ		000-505-429	
	RELAY	ﾘﾚｰ		
K 1	MR31-12		000-454-079	
K 2	MR31-12		000-454-079	
K 3	SCD2A		000-458-150	
K 101	RRS51A12		000-455-198	
K 201	RRS51A12		000-455-198	
	COIL	ｺｲﾙ		
L 1	RL-4157	330UH	000-734-157	
L 2	T12-650-FD	287 UH	000-730-112	
L 3	T12-650-FD	287 UH	000-730-112	
L 101	RL-3214	12-3-3214	000-733-214	
L 102	EL0710-360K00S0037	36UH 205MA	000-427-630	
L 181	RL-4485		000-734-485	
L 1301	SC-10-100		000-424-980	
	PLUG	ﾌﾟﾗｸﾞ		
P 1	H6P-SHF-AA,6P	NH HOUSING	000-505-599	
	LHF-001T-08S		000-505-301	CONTACT 6PCS
P 2	H15P-SHF-AA,15P	NH HOUSING	000-505-606	
	LHF-001T-08S		000-505-301	CONTACT 13PCS
P 3	H3P-SHF-AA,3P	NH HOUSING	000-505-596	
	LHF-001T-08S		000-505-301	CONTACT 2PCS
P 51	H6P-SHF-AA,6P	NH HOUSING	000-505-599	
	LHF-001T-08S		000-505-301	CONTACT 6PCS
P 52	H15P-SHF-AA,15P	NH HOUSING	000-505-606	
	LHF-001T-08S		000-505-301	CONTACT 12PCS
P 53	H5P-SHF-AA,5P	NH HOUSING	000-505-598	
	LHF-001T-08S		000-505-301	CONTACT 2PCS
P 54	H4P-SHF-AA,4P	NH HOUSING	000-505-597	
	LHF-001T-0.8SS		000-505-493	CONTACT 4PCS
P 55	H2P-SHF-AA,2P	NH HOUSING	000-505-595	
	LHF-001T-08S		000-505-301	CONTACT 2PCS
P 56	H3P-SHF-AA,3P	NH HOUSING	000-505-596	
	LHF-001T-08S		000-505-301	CONTACT 2PCS
P 57	H4P-SHF-AA,4P	NH HOUSING	000-505-597	
	LHF-001T-08S		000-505-301	CONTACT 3PCS
P 58	H4P-SHF-AA,4P	NH HOUSING	000-505-597	
	LHF-001T-08S		000-505-301	CONTACT 2PCS
P 59	H10P-SHF-AA,10P	NH HOUSING	000-505-603	
	LHF-001T-08S		000-505-301	CONTACT 8PCS
P 60	H9P-SHF-AA,9P	NH HOUSING	000-505-602	
	LHF-001T-08S		000-505-301	CONTACT 9PCS
P 151	H4P-SHF-AA,4P	NH HOUSING	000-505-597	
	LHF-001T-08S		000-505-301	CONTACT 2PCS
P 201	CN-7042 BLK		000-510-580	
P 501	LDF-0.1T-1.3AS		000-538-143	
P 503	H9P-SHF-AA,9P	NH HOUSING	000-505-602	
	LHF-001T-08S		000-505-301	CONTACT 5PCS
P 504	S8-502B-30		000-510-105	CRT SOCKET
P 1301	S4P-SVF SV HOUSING	FD-120	000-505-520	
	SVF-01T-1.5N	FD-120	000-505-379	CONTACT 4PCS
P 1651	H6P-SHF-AA,6P	NH HOUSING	000-505-599	
	LHF-001T-08S		000-505-301	CONTACT 6PCS
P 1652	H3P-SHF-AA,3P	NH HOUSING	000-505-596	
	LHF-001T-08S		000-505-301	CONTACT 3PCS
	TRANSISTOR	ﾄﾗﾝｼﾞｽﾀｰ		
Q 1	2SC945		000-124-420	
Q 2	2SA467GTM-O		000-116-930	
Q 3	2SA467GTM-O		000-116-930	
Q 4	2SC2334,6,K G-21ACﾂｷ		000-126-152	
Q 5	2SC2334,6,K G-21ACﾂｷ		000-126-152	
Q 6	2SC945		000-124-420	
Q 7	2SC945		000-124-420	
Q 101	2SC367GTM-O		000-123-552	
Q 102	2SA467GTM-O		000-116-930	
Q 103	2SA778-K		000-117-520	
Q 104	2SA495GTM-O		000-116-992	
Q 105	2SC367GTM-O		000-123-552	
Q 106	2SC2837-O		000-126-301	
Q 107	2SC367GTM-O		000-123-552	
Q 108	2SC367GTM-O		000-123-552	
Q 109	2SA495GTM-O		000-116-992	

NOTE:
備 考:

SYMBOL 記 号	TYPE 型 名	SPECIFICATIONS 規 格	CODE NO. コード番号	REMARKS 備 考
Q 110	2SA495GTM-0		000-116-992	
Q 111	2SC945		000-124-420	
Q 201	2SC1569		000-125-117	
Q 401	2SA1020-Y		000-118-050	
Q 1301	2SB434Y		000-120-871	
Q 1302	2SA743A-C		000-117-466	
Q 1303	2SA743A-C		000-117-466	
Q 1304	2SC2334,6,K G-21ACツキ		000-126-152	
Q 1305	2SC2334,6,K G-21ACツキ		000-126-152	
Q 1306	2SC2334,6,K G-21ACツキ		000-126-152	
Q 1307	2SC2334,6,K G-21ACツキ		000-126-152	
	RESISTOR	テイコウ		
R 1	ERD-25TJ101	0.25W 100	000-330-333	
R 3	ERD-25TJ821	0.25W 820	000-330-355	
R 4	ERD-25TJ102	0.25W 1K	000-330-357	
R 5	ERD-25TJ183	0.25W 18K	000-330-387	
R 6	ERD-25TJ222	0.25W 2.2K	000-330-365	
R 7	ERG-1ANJ680	1W, 68	000-371-086	
R 8	ERG-1ANJ680	1W, 68	000-371-086	
R 9	ERD-25TJ100	0.25W 10	000-330-309	
R 10	ERD-25TJ100	0.25W 10	000-330-309	
R 11	ERG-1ANJ330	1W 33	000-371-226	
R 12	ERX-1ANJ5R1	1W 5.1	000-371-072	
R 13	ERX-1ANJ1R0	1W 1	000-371-055	
R 14	ERG-1ANJ153	1W 15K	000-371-309	
R 15	ERD-50TJ124	0.5W 120K	000-330-107	
R 16	ERD-50TJ124	0.5W 120K	000-330-107	
R 17	ERD-50TJ124	0.5W 120K	000-330-107	
R 18	ERD-25TJ472	0.25W 4.7K	000-330-373	
R 19	ERD-25TJ472	0.25W 4.7K	000-330-373	
R 101	ERD-25TJ222	0.25W 2.2K	000-330-365	
R 102	ERD-25TJ472	0.25W 4.7K	000-330-373	
R 103	EXBP88822K	8.2K X 8	000-378-509	
R 104	ERD-25TJ102	0.25W 1K	000-330-357	
R 105	ERD-25TJ152	0.25W 1.5K	000-330-361	
R 106	ERD-25TJ102	0.25W 1K	000-330-357	
R 107	ERD-25TJ821	0.25W 820	000-330-355	
R 108	ERD-25TJ152	0.25W 1.5K	000-330-361	
R 109	ERD-25TJ331	0.25W 330	000-330-345	
R 110	ERD-25TJ680	0.25W 68	000-330-329	
R 111	ERD-25TJ102	0.25W 1K	000-330-357	
R 112	ERD-25TJ330	0.25W 33	000-330-321	
R 113	ERD-25TJ223	0.25W 22K	000-330-389	
R 114	ERD-25TJ222	0.25W 2.2K	000-330-365	
R 115	ERD-25TJ223	0.25W 22K	000-330-389	
R 116	ERD-25TJ103	0.25W 10K	000-330-381	
R 117	ERG-1ANJ822	1W 8.2K	000-371-299	
R 118	ERD-25TJ393	0.25W 39K	000-330-395	
R 119	ERD-25TJ271	0.25W 270	000-330-343	
R 120	ERD-25TJ561	0.25W 560	000-330-351	
R 121	ERD-25TJ101	0.25W 100	000-330-333	
R 122	ERD-25TJ471	0.25W 470	000-330-349	
R 123	EXB-H89811G		000-379-100	
R 124	ERD-25TJ220	0.25W 22	000-330-317	
R 125	ERD-25TJ682	0.25W 6.8K	000-330-377	
R 126	ERD-25TJ102	0.25W 1K	000-330-357	
R 127	ERD-25TJ562	0.25W 5.6K	000-330-375	
R 128	ERD-25TJ104	0.25W 100K	000-330-405	
R 129	ERD-25TJ392	0.25W 3.9K	000-330-371	
R 130	ERD-25TJ153	0.25W 15K	000-330-385	
R 131	ERD-25TJ221	0.25W 220	000-330-341	
R 132	ERD-25TJ221	0.25W 220	000-330-341	
R 133	ERD-25TJ474	0.25W 470K	000-330-421	
R 134	ERD-25TJ154	0.25W 150K	000-330-409	
R 135	ERD-25TJ224	0.25W 220K	000-330-413	
R 136	ERD-25TJ220	0.25W 22	000-330-317	
R 137	ERD-25TJ302	0.25W 3K	000-330-368	
R 138	ERG-2ANJ820	2W 82	000-371-346	
R 139	ERD-25TJ102	0.25W 1K	000-330-357	
R 140	ERD-25TJ184	0.25W 180K	000-330-411	
R 141	ERX-2ANJ3R9	2W 3.9	000-371-163	
R 142	ERX-1ANJR62	1W 0.62	000-371-050	
R 143	ERD-25TJ680	0.25W 68	000-330-329	
R 144	ERD-25TJ102	0.25W 1K	000-330-357	
R 145	ERG-1ANJ471	1W 470	000-371-256	
R 147	ERD-25TJ272	0.25W 2.7K	000-330-367	
R 148	ERD-25TJ272	0.25W 2.7K	000-330-367	
R 149	ERD-25TJ272	0.25W 2.7K	000-330-367	
R 150	ERD-25TJ393	0.25W 39K	000-330-395	
R 151	ERD-25TJ472	0.25W 4.7K	000-330-373	
R 152	ERD-25TJ332	0.25W 3.3K	000-330-369	
R 153	ERD-25TJ562	0.25W 5.6K	000-330-375	
R 154	ERD-25TJ472	0.25W 4.7K	000-330-373	
R 155	ERD-25TJ562	0.25W 5.6K	000-330-375	
R 156	ERD-25TJ102	0.25W 1K	000-330-357	
R 157	ERD-25TJ332	0.25W 3.3K	000-330-369	
R 158	ERD-25TJ102	0.25W 1K	000-330-357	
R 159	ERD-25TJ333	0.25W 33K	000-330-393	
R 201	ERD-25TJ750	0.25W 75	000-330-330	
R 204	ERD-25TJ182	0.25W 1.8K	000-330-363	
R 205	ERD-25TJ100	0.25W 10	000-330-309	
R 206	ERD-25TJ821	0.25W 820	000-330-355	
R 207	ERD-25TJ103	0.25W 10K	000-330-381	
R 208	ERD-25TJ332	0.25W 3.3K	000-330-369	

SYMBOL 記 号	TYPE 型 名	SPECIFICATIONS 規 格	CODE NO. コード番号	REMARKS 備 考
R 209	ERD-25TJ472	0.25W 4.7K	000-330-373	
R 210	ERD-25TJ100	0.25W 10	000-330-309	
R 211	ERD-25TJ820	0.25W 82	000-330-331	
R 212	ERD-25TJ222	0.25W 2.2K	000-330-365	
R 213	ERD-25TJ222	0.25W 2.2K	000-330-365	
R 214	ERD-25TJ101	0.25W 100	000-330-333	
R 215	ERD-25TJ564	0.25W 560K	000-330-423	
R 216	ERD-25TJ101	0.25W 100	000-330-333	
R 217	ERD-25TJ272	0.25W 2.7K	000-330-367	
R 219	ERD-25TJ103	0.25W 10K	000-330-381	
R 221	ERD-25TJ121	0.25W 120	000-330-335	
R 222	ERD-25TJ271	0.25W 270	000-330-343	
R 223	ERD-25TJ182	0.25W 1.8K	000-330-363	
R 224	ERD-25TJ821	0.25W 820	000-330-355	
R 225	ERD-25TJ102	0.25W 1K	000-330-357	
R 226	ERD-25TJ102	0.25W 1K	000-330-357	
R 227	ERD-25TJ103	0.25W 10K	000-330-381	
R 301	ERD-25TJ472	0.25W 4.7K	000-330-373	
R 302	ERD-25TJ471	0.25W 470	000-330-349	
R 303	ERD-25TJ103	0.25W 10K	000-330-381	
R 401	ERD-25TJ224	0.25W 220K	000-330-413	
R 402	ERD-25TJ474	0.25W 470K	000-330-421	
R 403	ERD-25TJ103	0.25W 10K	000-330-381	
R 404	ERD-25TJ331	0.25W 330	000-330-345	
R 405	ERD-25TJ103	0.25W 10K	000-330-381	
R 406	ERD-25TJ471	0.25W 470	000-330-349	
R 407	ERD-25TJ103	0.25W 10K	000-330-381	
R 408	ERD-25TJ272	0.25W 2.7K	000-330-367	
R 409	ERX-1ANJ3R9	1W 3.9	000-371-069	
R 410	ERD-25TJ102	0.25W 1K	000-330-357	
R 412	ERX-1ANJ5R1	1W 5.1	000-371-072	
R 501	ERD-25TJ104	0.25W 100K	000-330-405	
R 502	ERD-25TJ274	0.25W 270K	000-330-415	
R 503	ERD-25TJ222	0.25W 2.2K	000-330-365	
R 504	ERD-25TJ154	0.25W 150K	000-330-409	
R 1301	ERD-25TJ101	0.25W 100	000-330-333	
R 1302	ERD-25TJ101	0.25W 100	000-330-333	
R 1303	ERX-1ANJ4R7	1W 4.7	000-371-071	
R 1304	ERX-1ANJ4R7	1W 4.7	000-371-071	
R 1305	ERD-25TJ150	0.25W 15	000-330-313	
R 1306	ERD-25TJ150	0.25W 15	000-330-313	
R 1307	ERG-1ANJ330	1W 33	000-371-226	
R 1308	ERD-25TJ271	0.25W 270	000-330-343	
R 1309	ERD-25TJ332	0.25W 3.3K	000-330-369	
R 1310	ERX-1ANJ4R7	1W 4.7	000-371-071	
R 1311	ERX-1ANJ4R7	1W 4.7	000-371-071	
R 1312	ERD-25TJ150	0.25W 15	000-330-313	
R 1313	ERD-25TJ150	0.25W 15	000-330-313	
R 1601	ERD-25TJ680	0.25W 68	000-330-329	
R 1602	ERD-25TJ681	0.25W 680	000-330-353	
R 1603	ERD-25TJ103	0.25W 10K	000-330-381	
	SWITCH	スイツチ		
S 101	RR-4592 RR-4600		000-460-345 000-460-350	FR360M2 MODEL2400/ FR-240M3
S 201				HD FL OFF SEE VR51
S 301				RANGE RING SEE VR401
S 401	RR-4265-1		000-634-265	
S 1351	ST-206N		000-470-067	ANT.SW
S 2201				INTRF.REJ. SEE VR601
	TRANSFORMER	トランス		
T 1	RT-4942		000-734-942	
T 2	RT-4589		000-734-589	
T 1301	RT-4098		000-734-098	
T 1302	RT-4098		000-734-098	
	TEST POINT	テストポイント		
TP 1	BE12P-SHF-1AA H12P-SHF-AA,12P LHF-001T-0.8SS	12P NH HOUSING	000-505-590 000-505-605 000-505-493	 HOUSING CONTACT 2PCS
TP 2	LC-2-S-YELLOW		000-537-970	
TP 3	LC-2-S-YELLOW		000-537-970	
TP 101	LC-2-S-YELLOW		000-537-970	
TP 102	LC-2-S-YELLOW		000-537-970	
TP 103	LC-2-S-YELLOW		000-537-970	
TP 104	LC-2-S-YELLOW		000-537-970	
TP 105	LC-2-S-YELLOW		000-537-970	

NOTE:

備 考:

SYMBOL 記号	TYPE 型名	SPECIFICATIONS 規格	CODE NO. コード番号	REMARKS 備考
TP 106	LC-2-S-YELLOW		000-537-970	
TP 107	LC-2-S-YELLOW		000-537-970	
TP 108	LC-2-S-YELLOW		000-537-970	
TP 201	LC-2-S-YELLOW		000-537-970	
TP 202	LC-2-S-YELLOW		000-537-970	
TP 301	LC-2-S-YELLOW		000-537-970	
TP 401	LC-2-S-YELLOW		000-537-970	
TP 402	B3P-SHF-1AA	3P	000-505-551	
TP 1301	LC-2-S-YELLOW		000-537-970	
TP 1302	LC-2-S-YELLOW		000-537-970	
TP 1303	BE5P-SHF-1AA		000-505-583	
	H5P-SHF-AA,5P	NH HOUSING	000-505-598	HOUSING
	LHF-001T-0.8SS		000-505-493	CONTACT 2PCS
	INTEGRATED CIRCUIT	ｼﾕｳｾｷｶｲﾛ		
U 1	PS2001B-M		000-134-355	
U 2	MC14538BCP	CMOS	000-170-016	
U 3	RC-4208-1		000-378-104	
U 4	RC-4208-1		000-378-104	
U 101	HD74LS148P		000-162-492	
U 102	HD74LS04P		000-162-404	
U 103	HD74LS393P		000-162-580	
U 104	HD74LS151P		000-162-510	
U 105	HD74LS161P		000-162-516	
U 106	HD74LS221P		000-162-530	
U 107	HD74LS161P		000-162-516	
U 108	HD74LS11P		000-162-411	
U 109	HD74LS26P		000-162-426	
U 110	HD74LS27P		000-162-427	
U 111	MC14541BCP		000-170-018	
U 112	HD74LS132P		000-162-485	
U 113	HD74LS04P		000-162-404	
U 114	HD74LS132P		000-162-485	
U 115	TC-4051BP	CMOS	000-163-257	
U 116	TL081CP		000-168-486	
U 117	UPC-157C	LINEAR	000-161-031	
U 118	TC-4051BP	CMOS	000-163-257	
U 119	HD74LS04P		000-162-404	
U 120	HD74LS73P		000-162-473	
U 201	RC-4232-2		000-164-256	
U 1301	MB3759M		000-157-500	
U 1302	RC-4210-1		000-164-253	
U 1303	RC-4214-1		000-378-100	
U 1601	TC4011BP	CMOS	000-163-245	
U 1602	TC4011BP	CMOS	000-163-245	
U 1603	TC4027BP	CMOS	000-163-251	
U 1604	TD62004P		000-163-091	
U 1605	RC-4211		000-164-254	
U 1651	ON1105		000-134-102	
	ELECTRON TUBE	ﾃﾞﾝｼｶﾝ		
V 551	180SB7		000-103-600	
	POTENTIOMETER	ﾎﾟﾃﾝｼﾖﾒｰﾀｰ		
VR 1	RGP102-501 13-3-3253	500	000-316-250	VOLT.ADJ.
VR 51	RV-4270-1	100	000-319-059	DIMMER VR W/S201
VR 101	RGP102-103	10K	000-316-260	SWEEP TIMING
VR 102	GFP06B		000-316-805	SWEEP VELOCITY
VR 103	RGP102-503	50K	000-316-261	THRESHOLD
VR 201	RGP102-202	2K	000-316-256	LIMITER
VR 202	RGP102-502	5K	000-316-259	GAIN PRESET
VR 301	RGP102-103	10K	000-316-260	RANGE RING TIMING
VR 401	RV-4267-1	2K, 50K	000-319-057	TUNING & BRILLIANCE DUAL VR W/S301
VR 402	RV-4269	20KX2	000-319-062	TUNING PRESET
VR 501	EVMR0GS20B17	10M	000-307-750	FOCUS
VR 502	RGP102-503	50K	000-316-261	BRILL. PRESET
VR 503	RGP102-204	0.5W 200K	000-316-267	BRILL. PRESET
VR 601	RV-4268-1	2K, 5K	000-319-058	GAIN & STC DUAL VR W/S2201
VR 1301	RGP102-502	5K	000-316-259	FREQ.ADJ.

SYMBOL 記号	TYPE 型名	SPECIFICATIONS 規格	CODE NO. コード番号	REMARKS 備考
	FUSE HOLDER	ﾋﾕｰｽﾞ ﾎﾙﾀﾞｰ		
XF 1	FH001	6.4MM X 30MM	000-519-180	
XF 1351	FH001	6.4MM X 30MM	000-519-180	
XF 1352	FH001	6.4MM X 30MM	000-519-180	
	CRYSTAL	ｸﾘｽﾀﾙ		
Y 101	CSA2.59MA1		000-491-030	

NOTE:
備 考:

INTERFERENCE REJECTOR 干渉除去回路

REF.DWG.No. 参照図番: C3237-012-H

SYMBOL 記号	TYPE 型名	SPECIFICATIONS 規格	CODE NO. コード番号	REMARKS 備考
	PRINTED CIRCUIT BOARDﾌﾟﾘﾝﾄｷﾊﾞﾝ			
	IR-3695 I.REJECTOR		003-002-760	
	CAPACITOR	ｺﾝﾃﾞﾝｻｰ		
C 2251	DM15C101K1	100PF 100V	000-222-220	
C 2253	DM15C471K1	470PF, 100V	000-222-280	
C 2254	ECE-A1CS101	100UF 16V	000-201-427	
C 2255	DM15C331K1	330PF, 100V	000-222-260	
C 2256	ECE-A1CS101	100UF 16V	000-201-427	
C 2257	ECE-A1CS101	100UF 16V	000-201-427	
C 2258	DM15C331K1	330PF, 100V	000-222-260	
C 2259	ECE-A1CS101	100UF 16V	000-201-427	
C 2260	ECE-A1CS101	100UF 16V	000-201-427	
C 2261	ECE-A1CS101	100UF 16V	000-201-427	
C 2262	DD610BC204Z	0.2UF 12WV	000-252-260	
C 2263	DD610BC204Z	0.2UF 12WV	000-252-260	
C 2264	DD610BC204Z	0.2UF 12WV	000-252-260	
C 2265	DD610BC204Z	0.2UF 12WV	000-252-260	
C 2266	DD610BC204Z	0.2UF 12WV	000-252-260	
C 2267	DD610BC204Z	0.2UF 12WV	000-252-260	
C 2268	DD610BC204Z	0.2UF 12WV	000-252-260	
C 2269	DD610BC204Z	0.2UF 12WV	000-252-260	
C 2270	DD610BC204Z	0.2UF 12WV	000-252-260	
C 2271	DD610BC204Z	0.2UF 12WV	000-252-260	
C 2273	DD109E103P50V02	0.01UF 50V	000-253-436	
C 2274	DD109E103P50V02	0.01UF 50V	000-253-436	
C 2275	DD109E103P50V02	0.01UF 50V	000-253-436	
C 2276	DD109E103P50V02	0.01UF 50V	000-253-436	
C 2278	DM15C101K1	100PF 100V	000-222-220	
C 2279	DM15C101K1	100PF 100V	000-222-220	
	DIODE	ﾀﾞｲｵｰﾄﾞ		
CR 2251	RD-3.0EB		000-134-796	
CR 2252	1S1588		000-112-795	
CR 2253	1S1588		000-112-795	
CR 2254	1S1588		000-112-795	
CR 2255	1S1588		000-112-795	
CR 2256	1S1588		000-112-795	
CR 2257	TLR-121		000-135-840	
CR 2258	TLR-121		000-135-840	
	JACK	ｼﾞﾔﾂｸ		
J 2253	B12P-SHF-1AA	12P	000-505-560	
J 2254	CN-3561 1P (F)		000-510-559	
J 2255	B2P-SHF-1AA	2P	000-505-550	
	COIL	ｺｲﾙ		
L 2251	315-2820		000-732-820	
	PLUG	ﾌﾟﾗｸﾞ		
P 2251	B7P-SHF-1AA	7P	000-505-555	
P 2252	B20P-SHF-1AA	20P	000-505-562	
P 2255	H2P-SHF-AA,2P	NH HOUSING	000-505-595	HOUSING
	LHF-001T-08S		000-505-301	2PCS. CONTACT
P 2256	H2P-SHF-AA,2P	NH HOUSING	000-505-595	HOUSING
	LHF-001T-08S		000-505-301	2PCS. CONTACT
	TRANSISTOR	ﾄﾗﾝｼﾞｽﾀｰ		
Q 2251	2SA495GTM-O		000-116-992	
Q 2252	2SA495GTM-O		000-116-992	
Q 2253	2SA495GTM-O		000-116-992	
Q 2254	2SA715C		000-117-430	
	RESISTOR	ﾃｲｺｳ		
R 2252	ERD-25TJ472	0.25W 4.7K	000-330-373	
R 2253	ERD-25TJ472	0.25W 4.7K	000-330-373	
R 2254	ERD-25TJ471	0.25W 470	000-330-349	
R 2255	ERD-25TJ152	0.25W 1.5K	000-330-361	
R 2256	ERD-25TJ472	0.25W 4.7K	000-330-373	
R 2257	ERD-25TJ332	0.25W 3.3K	000-330-369	
R 2258	ERD-25TJ101	0.25W 100	000-330-333	
R 2259	ERD-25TJ101	0.25W 100	000-330-333	
R 2260	ERD-25TJ101	0.25W 100	000-330-333	
R 2261	ERD-25TJ271	0.25W 270	000-330-343	
R 2262	ERD-25TJ222	0.25W 2.2K	000-330-365	
R 2263	ERD-25TJ102	0.25W 1K	000-330-357	
R 2264	ERD-25TJ561	0.25W 560	000-330-351	
R 2265	ERD-25TJ470	0.25W 47	000-330-325	
R 2266	ERD-25TJ470	0.25W 47	000-330-325	
R 2267	ERD-25TJ221	0.25W 220	000-330-341	
R 2268	ERD-25TJ152	0.25W 1.5K	000-330-361	
R 2269	ERD-25TJ562	0.25W 5.6K	000-330-375	
R 2270	ERD-25TJ471	0.25W 470	000-330-349	
R 2271	ERD-25TJ102	0.25W 1K	000-330-357	
R 2272	ERD-25TJ102	0.25W 1K	000-330-357	
R 2273	ERD-25TJ472	0.25W 4.7K	000-330-373	
R 2274	ERD-25TJ102	0.25W 1K	000-330-357	
R 2275	ERD-25TJ102	0.25W 1K	000-330-357	
R 2276	ERD-25TJ471	0.25W 470	000-330-349	
R 2277	ERD-25TJ102	0.25W 1K	000-330-357	
R 2278	ERD-25TJ102	0.25W 1K	000-330-357	
	INTEGRATED CIRCUIT	ｼﾕｳｾｷｶｲﾛ		
U 2251	M53203P	TTL	000-150-703	
U 2252	M53203P	TTL	000-150-703	
U 2253	M53204P	TTL	000-150-704	
U 2254	M53220P	TTL	000-150-720	
U 2255	M53293P	TTL	000-150-793	
U 2256	M53293P	TTL	000-150-793	
U 2257	M53200P	TTL	000-150-700	
U 2258	M53273P	TTL	000-150-773	
U 2260	TC-4050BP	CMOS	000-163-256	
U 2261	M53295P	TTL	000-150-794	
U 2262	M53217P		000-150-717	
U 2263	MC-14517BCP	CMOS	000-170-012	
U 2264	MC-14517BCP	CMOS	000-170-012	
	POTENTIOMETER	ﾎﾟﾃﾝｼﾖﾒｰﾀｰ		
VR 2251	RGP102-102 13-3-3253	1K	000-316-255	

EVRM 可変距離環装置

REF.DWG.No. 参照図番: C3237-011-E

SYMBOL 記号	TYPE 型名	SPECIFICATIONS 規格	CODE NO. コード番号	REMARKS 備考
	PRINTED CIRCUIT BOARDﾌﾟﾘﾝﾄｷﾊﾞﾝ			
	EVRM-3692		003-006-240	
	CAPACITOR	ｺﾝﾃﾞﾝｻｰ		
C 2851	ECQ-M1H223KZ	0.022UF 50V	000-260-375	
C 2852	ECQ-M1H103KZ	0.01UF 50V	000-260-370	
C 2853	DM15C221K1	220PF, 100V	000-222-250	
C 2854	ECEA1ES4R7	4.7UF 25V	000-201-435	
C 2855	ECQ-M 1H 472KZ	4700PF 50V	000-260-365	
C 2856	ECQ-M1H103KZ	0.01UF 50V	000-260-370	
C 2857	ECQ-M1H223KZ	0.022UF 50V	000-260-375	
C 2858	ECE-A1CS100	10UF 16V	000-201-423	
C 2859	DM15C471K1	470PF, 100V	000-222-280	
C 2860	DM15C101K1	100PF 100V	000-222-220	
C 2861	ECE-A1HS010	1UF 50V	000-201-459	
C 2862	DD109E103P50V02	0.01UF 50V	000-253-436	
C 2863	DD109E103P50V02	0.01UF 50V	000-253-436	
C 2864	DD109E103P50V02	0.01UF 50V	000-253-436	
C 2865	DD109E103P50V02	0.01UF 50V	000-253-436	
C 2866	DD109E103P50V02	0.01UF 50V	000-253-436	
C 2867	DD109E103P50V02	0.01UF 50V	000-253-436	
C 2868	DD109E103P50V02	0.01UF 50V	000-253-436	
C 2869	DD109E103P50V02	0.01UF 50V	000-253-436	
C 2870	DD109E103P50V02	0.01UF 50V	000-253-436	
C 2871	DD610BC204Z	0.2UF 12WV	000-252-260	
C 2872	DD610BC204Z	0.2UF 12WV	000-252-260	
C 2873	DD610BC204Z	0.2UF 12WV	000-252-260	
C 2874	DD610BC204Z	0.2UF 12WV	000-252-260	
C 2875	DD610BC204Z	0.2UF 12WV	000-252-260	
C 2876	DD610BC204Z	0.2UF 12WV	000-252-260	
C 2877	DD610BC204Z	0.2UF 12WV	000-252-260	
C 2878	ECE-A1CS101	100UF 16V	000-201-427	
C 2879	ECE-A1CS101	100UF 16V	000-201-427	
C 2880	ECE-A1CS100	10UF 16V	000-201-423	
C 2881	ECQ-M1H102KZ	1000PF 50V	000-260-360	
C 2884	DD610BC204Z	0.2UF 12WV	000-252-260	
C 2885	DD610BC204Z	0.2UF 12WV	000-252-260	
	DIODE	ﾀﾞｲｵｰﾄﾞ		
CR 2851	1S1588		000-112-795	
CR 2852	1S1588		000-112-795	
CR 2861	TLR-4125		000-135-855	

NOTE:

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SYMBOL 記号	TYPE 型名	SPECIFICATIONS 規格	CODE NO. コード番号	REMARKS 備考
	JACK	ｼﾞｬｯｸ		
J 2851	B20P-SHF-1AA	20P	000-505-562	
J 2861	B6P-SHF-1AA	6P	000-505-554	
J 2862	B7P-SHF-1AA	7P	000-505-555	
	PLUG	ﾌﾟﾗｸﾞ		
P 2851	H20P-SHF-AA,20P LHF-001T-08S	NH HOUSING	000-505-607 000-505-301	HOUSING 20PCS. CONTACT
P 2852	B9P-SHF-1AA	9P	000-505-557	
P 2861	H6P-SHF-AA,6P LHF-001T-08S	NH HOUSING	000-505-599 000-505-301	HOUSING 6PCS. CONTACT
P 2862	H7P-SHF-AA,7P LHF-001T-08S	NH HOUSING	000-505-600 000-505-301	HOUSING 7PCS. CONTACT
	TRANSISTOR	ﾄﾗﾝｼﾞｽﾀｰ		
Q 2851	2SC752GTM-0		000-124-129	
Q 2852	2SC367GTM-0		000-123-552	
Q 2853	2SA495GTM-0		000-116-992	
Q 2854	2SC945		000-124-420	
Q 2855	2SC945		000-124-420	
Q 2856	2SC945		000-124-420	
Q 2857	2SC945		000-124-420	
Q 2858	2SC945		000-124-420	
Q 2859	2SC945		000-124-420	
	RESISTOR	ﾃｲｺｳ		
R 2851	ERD-25TJ222	0.25W 2.2K	000-330-365	
R 2852	ERD-25TJ222	0.25W 2.2K	000-330-365	
R 2853	ERD-25TJ103	0.25W 10K	000-330-381	
R 2854	ERD-25TJ103	0.25W 10K	000-330-381	
R 2855	ERD-25TJ153	0.25W 15K	000-330-385	
R 2856	ERD-25TJ102	0.25W 1K	000-330-357	
R 2857	ERD-25TJ153	0.25W 15K	000-330-385	
R 2858	ERD-25TJ472	0.25W 4.7K	000-330-373	
R 2859	ERD-25TJ123	0.25W 12K	000-330-383	
R 2860	ERD-25TJ392	0.25W 3.9K	000-330-371	
R 2861	ERD-25TJ221	0.25W 220	000-330-341	
R 2862	ERD-25TJ472	0.25W 4.7K	000-330-373	
R 2863	ERD-25TJ122	0.25W 1.2K	000-330-359	
R 2864	ERD-25TJ151	0.25W 150	000-330-337	
R 2865	ERD-25TJ271	0.25W 270	000-330-343	
R 2866	ERD-25TJ103	0.25W 10K	000-330-381	
R 2867	ERD-25TJ223	0.25W 22K	000-330-389	
R 2868	ERD-25TJ123	0.25W 12K	000-330-383	
R 2869	ERD-25TJ103	0.25W 10K	000-330-381	
R 2870	ERD-25TJ102	0.25W 1K	000-330-357	
R 2871	ERD-25TJ102	0.25W 1K	000-330-357	
R 2872	ERD-25TJ472	0.25W 4.7K	000-330-373	
R 2873	ERD-25TJ103	0.25W 10K	000-330-381	
R 2874	ERD-25TJ222	0.25W 2.2K	000-330-365	
R 2875	ERD-25TJ222	0.25W 2.2K	000-330-365	
R 2876	ERD-25TJ222	0.25W 2.2K	000-330-365	
R 2877	ERD-25TJ222	0.25W 2.2K	000-330-365	
R 2878	ERD-25TJ331	0.25W 330	000-330-345	
R 2879	ERD-25TJ331	0.25W 330	000-330-345	
R 2880	ERD-25TJ331	0.25W 330	000-330-345	
R 2881	ERD-25TJ331	0.25W 330	000-330-345	
R 2882	ERD-25TJ331	0.25W 330	000-330-345	
R 2883	ERD-25TJ331	0.25W 330	000-330-345	
R 2884	ERD-25TJ331	0.25W 330	000-330-345	
R 2885	ERD-25TJ472	0.25W 4.7K	000-330-373	
R 2886	ERD-25TJ471	0.25W 470	000-330-349	
R 2887	ERD-25TJ472	0.25W 4.7K	000-330-373	
R 2888	ERD-25TJ471	0.25W 470	000-330-349	
R 2889	ERD-25TJ332	0.25W 3.3K	000-330-369	
R 2890	ERD-25TJ332	0.25W 3.3K	000-330-369	
R 2891	ERD-25TJ222	0.25W 2.2K	000-330-365	
R 2892	ERD-25TJ222	0.25W 2.2K	000-330-365	
R 2893	ERD-25TJ272	0.25W 2.7K	000-330-367	
R 2894	ERD-25TJ102	0.25W 1K	000-330-357	
	THERMISTOR	ｻｰﾐｽﾀｰ		
RT 2851	D-33A		000-180-625	

SYMBOL 記号	TYPE 型名	SPECIFICATIONS 規格	CODE NO. コード番号	REMARKS 備考
	INTEGRATED CIRCUIT	ｼｭｳｾｷｶｲﾛ		
U 2851	M53293P	TTL	000-150-793	
U 2852	M53293P	TTL	000-150-793	
U 2853	M53274P	TTL	000-150-774	
U 2854	M53200P	TTL	000-150-700	
U 2855	M53202P	TTL	000-150-702	
U 2856	TC4520BP	CMOS	000-163-292	
U 2857	TC4013BP	CMOS	000-163-247	
U 2858	TC4011BP	CMOS	000-163-245	
U 2859	TC4023BP	CMOS	000-163-282	
U 2860	TC4049BP	CMOS	000-163-255	
U 2861	TC4049BP	CMOS	000-163-255	
U 2862	TC4013BP	CMOS	000-163-247	
U 2863	TC5001P	CMOS	000-163-298	
U 2864	TC5002BP	CMOS	000-163-299	
U 2865	TC4528BP	CMOS	000-163-293	
U 2866	UPC151C	LINEAR	000-161-051	
U 2867	TA7555P		000-163-007	
U 2868	TA78L008P	REGULATOR	000-163-608	
	POTENTIOMETER	ﾎﾟﾃﾝｼｮﾒｰﾀｰ		
VR 2851	RGP102-202	2K	000-316-256	
VR 2852	RGP102-103	10K	000-316-260	
VR 2861	EWS-5MA R29 083	1K + 5K	000-310-130	
VR 2862	EVC-80AS15B34	30K	000-302-931	

8MHz CLOCK BOARD 8MHz クロック基板

REF.DWG.No. 参照図番: C3255-006-A

SYMBOL 記号	TYPE 型名	SPECIFICATIONS 規格	CODE NO. コード番号	REMARKS 備考
	PRINTED CIRCUIT BOARD	ﾌﾟﾘﾝﾄｷﾊﾞﾝ		
	CG-4257 CLOCK/EVRM		003-009-250	
	CAPACITOR	ｺﾝﾃﾞﾝｻｰ		
C 181	ECQ-M1H473KZ	47000PF 50V	000-260-385	
C 182	ECQ-M1H473KZ	47000PF 50V	000-260-385	
C 183	DD610BC204Z	0.2UF 12WV	000-252-260	
	PLUG	ﾌﾟﾗｸﾞ		
P 2853	BS5P-SHF-1AA		000-505-568	
	RESISTOR	ﾃｲｺｳ		
R 181	ERD-25TJ821	0.25W 820	000-330-355	
R 182	ERD-25TJ561	0.25W 560	000-330-351	
	INTEGRATED CIRCUIT	ｼｭｳｾｷｶｲﾛ		
U 181	M74LS04P	TTL	000-151-204	
	CRYSTAL	ｸﾘｽﾀﾙ		
Y 181	RX-1794 HC-18/U	8093.75KHZ	000-631-794	

NOTE:
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SYMBOL 記　号		PARTS NAME 部　品　名	TYPE／DWG. NO. 型名／図　番	CODE NO. コード番号	REMARKS 備　考
A	201A	DISPLAY ASSY.	1P2-2400S	000-081-841	※1
A	201A	DISPLAY ASSY.	1P2-2400U	000-081-842	※2
A	201A	DISPLAY ASSY.	1P2-2400A	000-081-843	※3
A	201A	DISPLAY ASSY.	1P2-2400N	000-081-894	※4
A	201A	DISPLAY ASSY.	1P2-240M3(S)	000-081-844	※5
A	201A	DISPLAY ASSY.	1P2-240M3(U)	000-081-845	※6
A	201A	DISPLAY ASSY.	1P2-240M3(A)	000-081-846	※7
A	201A	DISPLAY ASSY.	1P2-240M3(N)	000-081-895	※8
A	201A	DISPLAY ASSY.	1P3-360M2(S)	000-081-847	※9
A	201A	DISPLAY ASSY.	1P3-360M2(U)	000-081-848	※10
A	201A	DISPLAY ASSY.	1P3-360M2(A)	000-081-849	※11
A	201A	DISPLAY ASSY.	1P3-360M2(N)	000-081-896	※12
A	203	DISPLAY COVER	03-008-1031-0	300-810-310	
A	204	LAMP BASE	03-004-1011-4	300-410-114	
A	205	MOUNTING CRADLE	03-004-1020-0	300-410-200	
A	206	COVER FIXING METAL	RDAA-0103-1	353-201-031	
A	207	WING KNOB ※1※	03-004-1061-0	300-410-610	
A	208	WING KNOB ※2※	03-004-1062-0	300-410-620	
A	209	KNOB ※SINGLE※	03-004-1064-0	300-410-640	
A	210	KNOB ※DOUBLE※	03-004-1065-0	300-410-650	
A	211	KNOB CAP	03-004-1066-0	300-410-660	
A	212	CURSOR KNOB	03-004-1063-0	300-410-630	
A	213	KNOB CAP	03-004-1066-0	300-410-660	
A	214	IDLE GEAR ASSEMBLY	M-1600	003-113-380	
A	215	ROLLER	03-001-1261-1	300-112-611	
A	216	ROLLER	03-001-1261-1	300-112-611	
A	217	CURSOR PANEL	03-004-1201-0	300-412-010	FOR GERMANY &NETHERLANDS
		CURSOR PANEL	03-008-1201-0	300-812-010	FOR OTHER THAN GERMANY &NETHERLANDS
A	218	HOOD FIXTURE	03-004-1202-2	300-412-022	
A	219	LIGHT SEAL RUBBER ※2※	03-004-1203-0	300-412-030	2PCS. ONLY FOR GERMANY &NETHERLANDS
A	220	CONTROL PANEL	03-008-1222	300-812-220	FOR MODEL2400 FR-240M3
		CONTROL PANEL	03-008-1223-0	300-812-230	FOR FR-360M2
A	221	RUBBER BUSH	03-004-1222-0	300-412-220	
A	222	RUBBER BUSH	03-004-1222-0	300-412-220	
A	223	RUBBER BUSH ※2※	03-004-1223-0	300-412-230	
A	224	CURSOR PLATE	03-004-1231-2	300-412-312	FOR OTHER THAN JAPAN
A	224	CURSOR PLATE	03-008-1231-0	300-812-310	FOR JAPAN
A	225	LIGHT SEAL RUBBER	03-004-1232-0	300-412-320	
A	226	PINCH ROLLER SUPPORT PLATE	03-004-1241-0	300-412-410	
A	227	CURSOR DRIVING GEAR	03-004-1261-1	300-412-611	
A	228	PCB COVER	03-008-1102-0	300-811-020	
A	231	CRT FIXING PLATE ASSEMBLY	M-1600	003-113-400	
A	232	CRT RETENTION RUBBER	R-12028-D	351-500-240	
A	233	CRT SUPPORT METAL	RDZ-1201-1	353-112-011	
A	234	CRT NECK COVER	03-004-1331-1	300-413-311	
A	235	REFLECTION PLATE	03-004-1106-0	300-411-060	2PCS.
A	236	REFLECTION PLATE	03-004-1106-0	300-411-060	
A	237	MAGNET MOUNT	03-004-1332-0	300-413-320	
A	238	CENTERING MAGNET	RP-4258	000-499-026	
A	239	CENTERING MAGNET	RP-4258	000-499-026	
A	240	SPACER	RP-4259	000-877-120	
A	241	CABLE BLIND PLATE	03-004-1133-1	300-411-331	
A	242	BLIND PLATE	03-004-1132-2	300-411-322	
A	243	SPACER	3MMDIA. X 8	000-877-013	
A	244	SPACER	3MMDIA. X 5	000-877-011	
A	245	SPACER	3MMDIA. X 5	000-877-011	
A	246	REFLECTION PLATE	03-004-1106-0	300-411-060	
A	250A	DEFLECTION TABLE ASSY.	2400/240M3/360M2	003-114-640	
A	251	DEFLECTION TABLE	03-004-1301-3	300-413-013	
A	252	MOTOR SHIELD CASE ※3※	03-001-1304-1	300-113-041	
A	253	MOTOR SHIELD CASE ※2※	RDS-3404-1	352-334-041	
A	254	ROLLER	SS 8-16ZZ WITH P6	000-875-206	
A	255	ROLLER	SS 8-16ZZ WITH P6	000-875-206	
A	256	SHUTTER	03-001-1322-1	300-113-221	
A	257	COIL DRIVING GEAR	03-004-1302-0	300-413-020	

NOTE:
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*1: MODEL 2400 FOR OUTSIDE JAPAN OTHER THAN USA & NETHERLANDS
*2: MODEL 2400 FOR USA
*3: MODEL 2400 FOR JAPAN
*4: MODEL 2400 FOR NETHERLANDS
*5: FR-240 MARK-III FOR OUTSIDE JAPAN OTHER THAN USA & NETHERLANDS
*6: FR-240 MARK-III FOR USA
*7: FR-240 MARK-III FOR JAPAN
*8: FR-240 MARK-III FOR NETHERLANDS
*9: FR-360 MARK-II FOR OUTSIDE JAPAN OTHER THAN USA & NETHERLANDS
*10: FR-360 MARK-II FOR USA
*11: FR-360 MARK-II FOR JAPAN
*12: FR-360 MARK-II FOR NETHERLANDS

MODEL 2400/FR-240 MARK-III/
FR-360 MARK-II DISPLAY UNIT

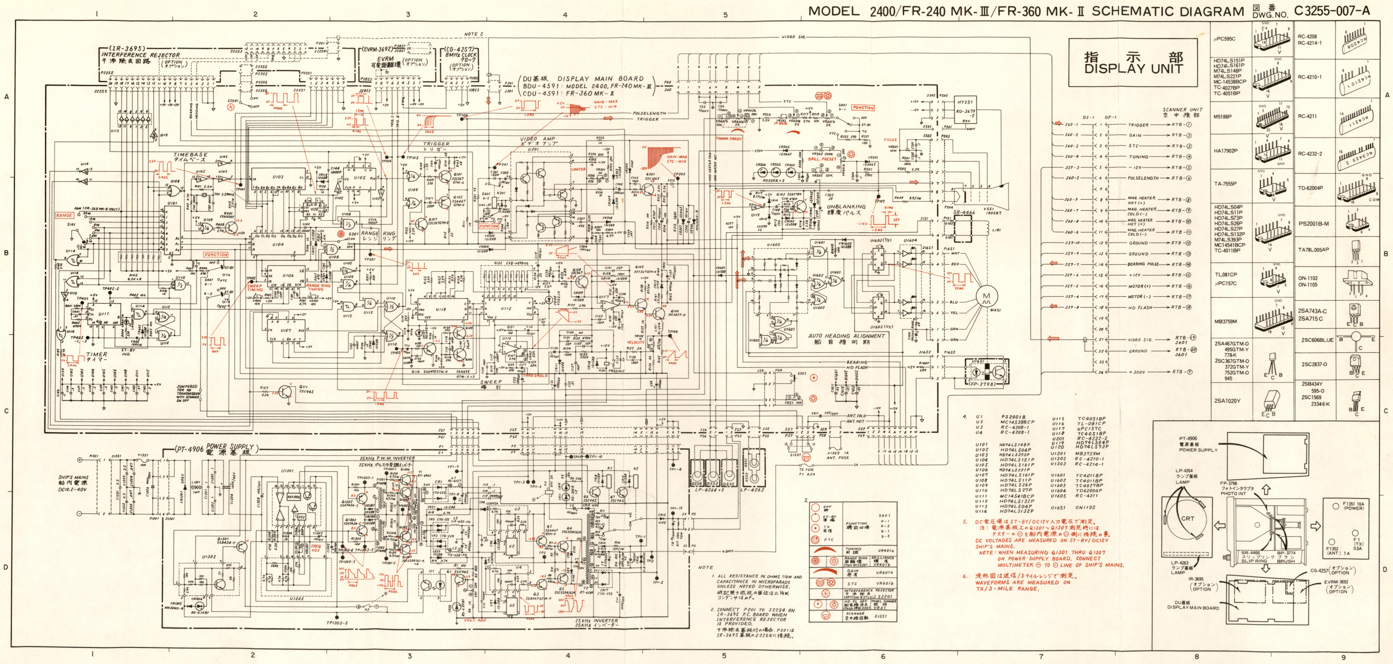
Ref. Dwg. No.
C3248-006-B
C3255-003-A
C3255-004-A

SYMBOL 記　号		PARTS NAME 部　品　名	TYPE／DWG. NO. 型名／図　番	CODE NO. コード番号	REMARKS 備　考
A	258	COIL TURNING GEAR	RDS-3201-4	352-332-014	
A	259	BEARING SHAFT ※1※	RDT-3002-0	352-430-020	
A	260	BEARING SHAFT ※2※	RDT-3003-0	352-430-030	
A	261A	PRINTED CIRCUIT BOARD	BP-3774 DEF BRUSH	003-114-260	
A	262A	PRINTED CIRCUIT BOARD	BP-3774 DEF BRUSH	003-114-260	
A	401	HOOD ※1※	03-004-1601	300-416-010	
A	402	HOOD ※2※	03-004-1602	300-416-020	
A	403	LENS	RCD-2144-1	351-600-431	
A	404	LENS SUPPORT RUBBER	RDP-8002-0	352-080-020	
A	405	RUBBER VISOR	RDP-8004-1	352-080-041	
A	406	RUBBER VIBRATION ISOLATOR	03-004-1603	300-416-030	6PCS
A	2003A	VIEWING HOOD ASSEMBLY	1P1-M1600	003-114-180	
BT	201	HEXAGONAL HEAD BOLT	M8 X 40 (SUS)	000-862-157	2PCS
BT	202	HEXAGONAL HEAD BOLT	M6 X 20	000-862-131	4PCS
BT	251	HEXAGONAL HEAD BOLT	M4 X 20	000-862-115	
N	201	HEXAGONAL NUT	M6	000-863-109	3PCS
N	202	HEXAGONAL NUT	M6	000-863-109	3PCS
S	201	WASHER HEAD SCREW ※A※	M3 X 6	000-881-103	4PCS
S	204	WASHER HEAD SCREW ※B※	M3 X 10	000-881-405	2PCS
S	205	PAN HEAD SCREW	M3 X 12	000-861-068	2PCS
S	206	WASHER HEAD SCREW ※B※	M3 X 15	000-881-407	
S	207	FILLISTER HEAD SCREW	M4 X 10	000-861-894	4PCS
S	208	WASHER HEAD SCREW ※A※	M3 X 6	000-881-103	2PCS
S	209	WASHER HEAD SCREW ※B※	M3 X 6	000-881-403	5PCS
S	210	WASHER HEAD SCREW ※A※	M3 X 6	000-881-103	4PCS
S	212	WASHER HEAD SCREW ※B※	M3 X 15	000-881-407	
S	213	SELF TAPPING SCREW	M3 X 6	000-867-581	8PCS
S	214	WASHER HEAD SCREW ※A※	M3 X 6	000-881-103	2PCS
S	215	WASHER HEAD SCREW ※B※	M4 X 10	000-881-446	4PCS
S	216	WASHER HEAD SCREW ※A※	M3 X 6	000-881-103	2PCS
S	217	NYLON PUSH RIVET	FNRP 3X5.5 WHITE	000-865-853	5PCS
S	218	WASHER HEAD SCREW ※A※	M3 X 6	000-881-103	2PCS
S	219	WASHER HEAD SCREW ※B※	M3 X 8	000-881-404	2PCS
S	220	PAN HEAD SCREW	M3 X 25	000-861-121	6PCS
S	222	WASHER HEAD SCREW ※B※	M4 X 10	000-881-446	4PCS
S	224	WASHER HEAD SCREW ※B※	M3 X 12	000-881-406	
S	225	WASHER HEAD SCREW ※A※	M4 X 10	000-881-145	4PCS
S	226	WASHER HEAD SCREW ※B※	M3 X 12	000-881-406	
S	227	WASHER HEAD SCREW ※B※	M3 X 15	000-881-407	
S	228	SOCKET SET SCREW	M3 X 4	000-861-601	2PCS
S	229	SOCKET SET SCREW	M3 X 4	000-861-601	
S	230	SOCKET SET SCREW	M3 X 4	000-861-601	
S	231	SOCKET SET SCREW	M3 X 4	000-861-601	2PCS
S	232	SOCKET SET SCREW	M3 X 4	000-861-601	2PCS
S	233	SOCKET SET SCREW	M3 X 4	000-861-601	2PCS
S	234	SOCKET SET SCREW	M3 X 4	000-861-601	
S	235	SOCKET SET SCREW	M3 X 4	000-861-601	2PCS
S	236	WASHER HEAD SCREW ※A※	M3 X 6	000-881-103	2PCS
S	251	WASHER HEAD SCREW ※A※	M3 X 8	000-881-104	4PCS
S	252	WASHER HEAD SCREW ※A※	M3 X 6	000-881-103	
S	253	WASHER HEAD SCREW ※B※	M4 X 20	000-881-451	2PCS
S	254	WASHER HEAD SCREW ※A※	M4 X 6	000-881-143	2PCS
S	256	WASHER HEAD SCREW ※A※	M3 X 6	000-881-103	4PCS
S	257	PAN HEAD SCREW	M3 X 10	000-861-115	2PCS
S	259	WASHER HEAD SCREW ※A※	M4 X 6	000-881-143	2PCS
S	260	WASHER HEAD SCREW ※B※	M3 X 10	000-881-405	2PCS
S	261	SOCKET SET SCREW	M3 X 4	000-861-601	2PCS
S	401	PAN HEAD SCREW	M3 X 18	000-861-118	4PCS
W	401	SPRING WASHER	M3	000-864-204	4PCS

NOTE:
備　考:

12 ft

MODEL 2400/FR-240 MK-Ⅲ/FR-360 MK-Ⅱ SCHEMATIC DIAGRAM 図番 DWG.NO. C3255-007-A


指示部
DISPLAY UNIT
(DU基板 DISPLAY MAIN BOARD
BDU-4591 MODEL 2400, FR-240MK-Ⅲ
CDU-4591 FR-360MK-Ⅱ)
(IR-3695)
INTERFERENCE REJECTOR
干渉除去回路
(OPTION オプション)
(EVRM-3692)
EVRM
可変距離環
(OPTION オプション)
(CG-4257)
8MHz CLOCK
クロック
(OPTION オプション)
TIMEBASE タイムベース
TRIGGER トリガ
VIDEO AMP ビデオアンプ
RANGE RING レンジリング
SWEEP 掃引
UNBLANKING 輝度パルス
AUTO HEADING ALIGNMENT 船首線同期
TIMER タイマー
RANGE
FUNCTION
PULSELENGTH
TRIGGER
VIDEO SIG.
(PT-4906) POWER SUPPLY 電源基板
SHIP'S MAINS 船内電源 DC10.2~40V
25KHz P.W.M. INVERTER
25KHz INVERTER 25KHzインバーター
LP-4264 ×3
LP-4263
TX FUSE F1 0.5A
F1352 1A ANT. FUSE
S1351
ANT. COLD
ANT. HOT
(FP-3798)
U1651
B1651
SCANNER UNIT 空中線部
TRIGGER → RTB-①
GAIN → RTB-②
STC → RTB-③
TUNING → RTB-④
-12V → RTB-⑤
PULSELENGTH → RTB-⑥
MAG. HEATER HOT(+) → RTB-⑧
MAG. HEATER COLD(-) → RTB-⑨
MAG. HEATER HOT(+) → RTB-⑩
MAG. HEATER COLD(-) → RTB-⑪
GROUND → RTB-⑫
GROUND → RTB-⑬
BEARING PULSE → RTB-⑭
+12V → RTB-⑮
MOTOR(+) → RTB-⑯
MOTOR(-) → RTB-⑰
HD FLASH → RTB-⑱
VIDEO SIG. → RTB-⑲ J601
GROUND → RTB-⑳ J601
+300V → RTB-⑦
HYSS1 RU-3679-2 8KV
μPC595C
HD74LS151P
HD74LS161P
M74LS148P
M74LS221P
MC-14538BCP
TC-4027BP
TC-4051BP
M5186P
HA17902P
TA-7555P
HD74LS04P
HD74LS11P
HD74LS73P
HD74LS26P
HD74LS27P
HD74LS132P
M74LS393P
MC14541BCP
TC-4011BP
TL081CP
μPC157C
MB3759M
2SA467GTM-O
495GTM-Y
778-K
2SC367GTM-O
372GTM-Y
752GTM-O
945
2SA1020Y
RC-4208
RC-4214-1
RC-4210-1
RC-4211
RC-4232-2
TD-62004P
PS2001B-M
TA78L005AP
ON-1102
ON-1105
2SA743A-C
2SA715 C
2SC606BLUE
2SC2837-O
2SB434Y
595-O
2SC1569
2334 6K
PT-4906 電源基板 POWER SUPPLY
LP-4264 ランプ基板 LAMP
FP-3798 フォトインタラプタ PHOTO INT
CRT
F1351 10A (POWER)
F1352 (ANT.) 1A
LP-4263 ランプ基板 LAMP
SR-4466 スリップリング SLIP RING
BP-3774
IR-3695 (オプション) OPTION
CG-4257 オプション OPTION
EVRM-3692 (オプション) OPTION
DU基板 DISPLAY MAIN BOARD

NOTE

1. ALL RESISTANCE IN OHMS 1/4W AND CAPACITANCE IN MICROFARADS UNLESS NOTED OTHERWISE.
特記無き抵抗の単位はΩ 1/4W, コンデンサはμF。

2. CONNECT P201 TO J2254 ON IR-3695 P.C. BOARD WHEN INTERFERENCE REJECTOR IS PROVIDED.
干渉除去基板付の場合、P201はIR-3695基板のJ2254に接続。

3.

○ OFF 断 ○ ST-BY 準備 ⊙ TX 送信 ● FTC	FUNCTION 機能切換	S401 a-1 a-2 b-1 b-2
◠	TUNING 同調	VR401a
◎ ¦ ☼	RANGE RING 距離環 (Pull 引く) S301	BRILLIANCE 輝度 VR401b
◠	GAIN 感度	VR601a
◎ ☼	STC	VR601b
⊛	INTERFERENCE REJECTOR 干渉除去 (OPTION オプション)	S2201
⊙ ¦ ☼	HD FL OFF 船首線消去 (Push 押す) S201	PANEL DIMMER 照明 VR51
⊖	SCANNER 空中線回転	S1351

4.

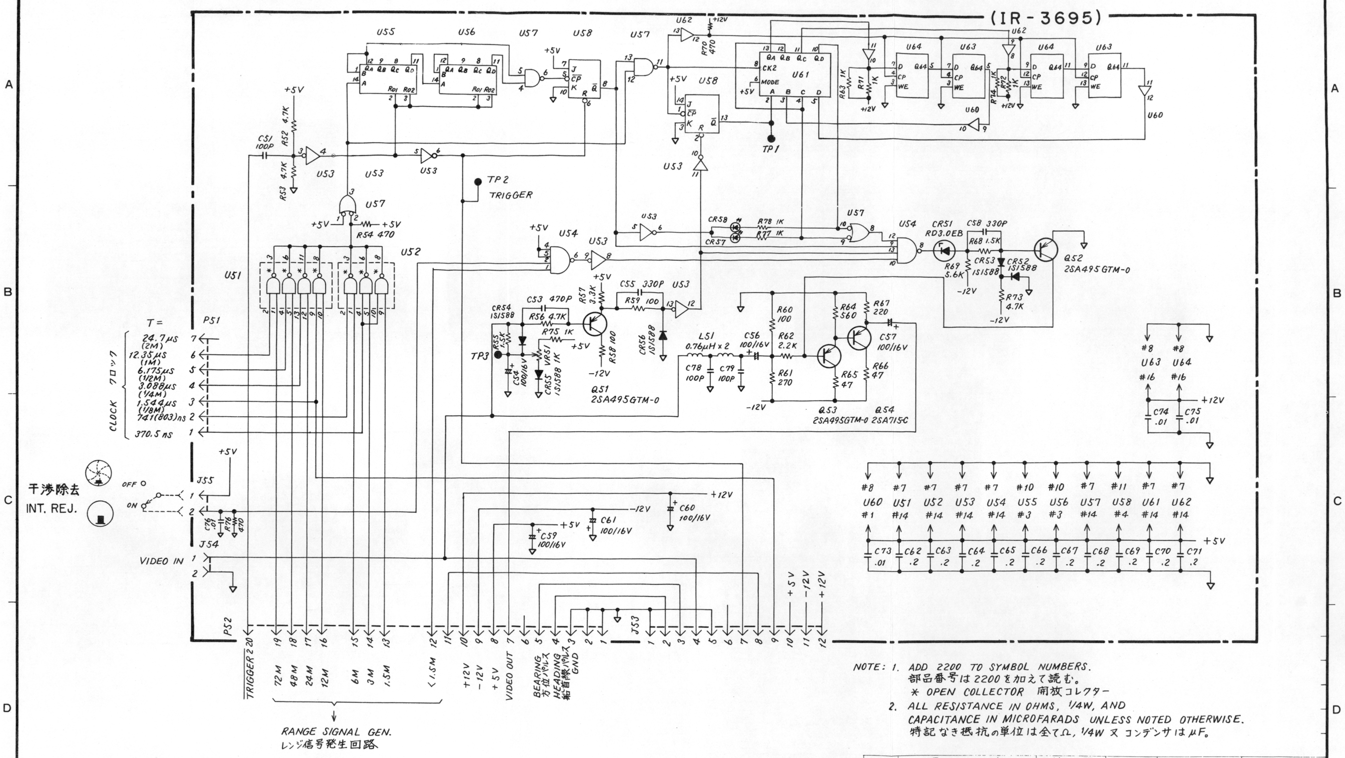
U1	PS2001B	U115	TC4051BP
U2	MC14538BCP	U116	TL-081CP
U3	RC-4208-1	U117	uPC157C
U4	RC-4208-1	U118	TC4051BP
		U201	RC-4232-2
U101	HD74LS148P	U119	HD74LS04P
U102	HD74LS04P	U120	HD74LS73P
U103	HD74LS393P	U1301	MB3759M
U104	HD74LS151P	U1302	RC-4210-1
U105	HD74LS161P	U1303	RC-4214-1
U106	HD74LS221P		
U107	HD74LS161P	U1601	TC4011BP
U108	HD74LS11P	U1602	TC4011BP
U109	HD74LS26P	U1603	TC4027BP
U110	HD74LS27P	U1604	TD62004P
U111	MC14541BCP	U1605	RC-4211
U112	HD74LS132P		
U113	HD74LS04P	U1651	ON1105
U114	HD74LS132P		

5. DC電圧値はST-BY/DC12V入力電圧で測定。
注：電源基板上のQ1301～Q1307測定時には、テスターの⊖を船内電源の⊖側に接続の事。
DC VOLTAGES ARE MEASURED ON ST-BY/DC12V SHIP'S MAINS.
NOTE: WHEN MEASURING Q1301 THRU Q1307 ON POWER SUPPLY BOARD, CONNECT MULTIMETER ⊖ TO ⊖ LINE OF SHIP'S MAINS.

6. 波形図は送信/3マイルレンジで測定。
WAVEFORMS ARE MEASURED ON TX/3-MILE RANGE.

FURUNO

S-2


1
2
3
4
5
6
A
B
C
D
(IR-3695)
U55
U56
U57
U58
U62
U61
U64
U63
U60
+12V
R70 470
+5V
TP1
TP2 TRIGGER
U53
U54
CS1 100P
R52 4.7K
R53 4.7K
R54 470
U51
U52
CR58
CR57
R78 1K
R77 1K
CR51 RD3.0EB
C58 330P
R68 1.5K
CR53 1S1588
CR52 1S1588
R69 5.6K
R73 4.7K
Q52 2SA495GTM-0
-12V
C53 470P
R56 4.7K
R75 1K
CR54 1S1588
R55 1.5K
TP3
C54 100/16V
VR51 1K
CR55 1S1588
R57 3.3K
R58 100
Q51 2SA495GTM-0
C55 330P
R59 100
CR56 1S1588
L51 0.76μH x 2
C56 100/16V
C78 100P
C79 100P
R60 100
R62 2.2K
R61 270
R64 560
R67 220
C57 100/16V
R65 47
R66 47
Q53 2SA495GTM-0
Q54 2SA715C
T=
24.7μs (2M)
12.35μs (1M)
6.175μs (1/2M)
3.088μs (1/4M)
1.544μs (1/8M)
741(803)ns
370.5 ns
CLOCK クロック
P51
干渉除去
INT. REJ.
OFF
ON
J55
C76 .01
R76 470
J54
VIDEO IN
C59 100/16V
C61 100/16V
C60 100/16V
C74 .01
C75 .01
C73 .01
C62 .2
C63 .2
C64 .2
C65 .2
C66 .2
C67 .2
C68 .2
C69 .2
C70 .2
C71 .2
U60 #1
U51 #14
U52 #14
U53 #14
U54 #14
U55 #3
U56 #3
U57 #14
U58 #4
U61 #14
U62 #14
P52
J53
TRIGGER 2
72M
48M
24M
12M
6M
3M
1.5M
<1.5M
+12V
-12V
+5V
VIDEO OUT
BEARING 方位パルス
HEADING 船首線パルス
GND
+5V
-12V
+12V
RANGE SIGNAL GEN.
レンジ信号発生回路

NOTE: 1. ADD 2200 TO SYMBOL NUMBERS.
部品番号は2200を加えて読む。
* OPEN COLLECTOR 開放コレクター
2. ALL RESISTANCE IN OHMS, 1/4W, AND
CAPACITANCE IN MICROFARADS UNLESS NOTED OTHERWISE.
特記なき抵抗の単位は全てΩ, 1/4W ヌ コンデンサはμF。

U51, 52 : M53203P
U53 : M53203P
U54 : M53204P
U55, 56 : M53293P
U57 : M53200P

U58 : M53273P
U60 : TC4050BP
U61 : M53295P
U62 : M53217P
U63, 64 : MC14517BCP

FR-700/1000/1200
SERIES
MODEL 2400
FR-240Ⅲ
FR-360Ⅱ

品番 ITEM	品名 NAME	材質 MATERIAL	数量 Q'TY	図番 DWG. NO.	摘要 REMARKS

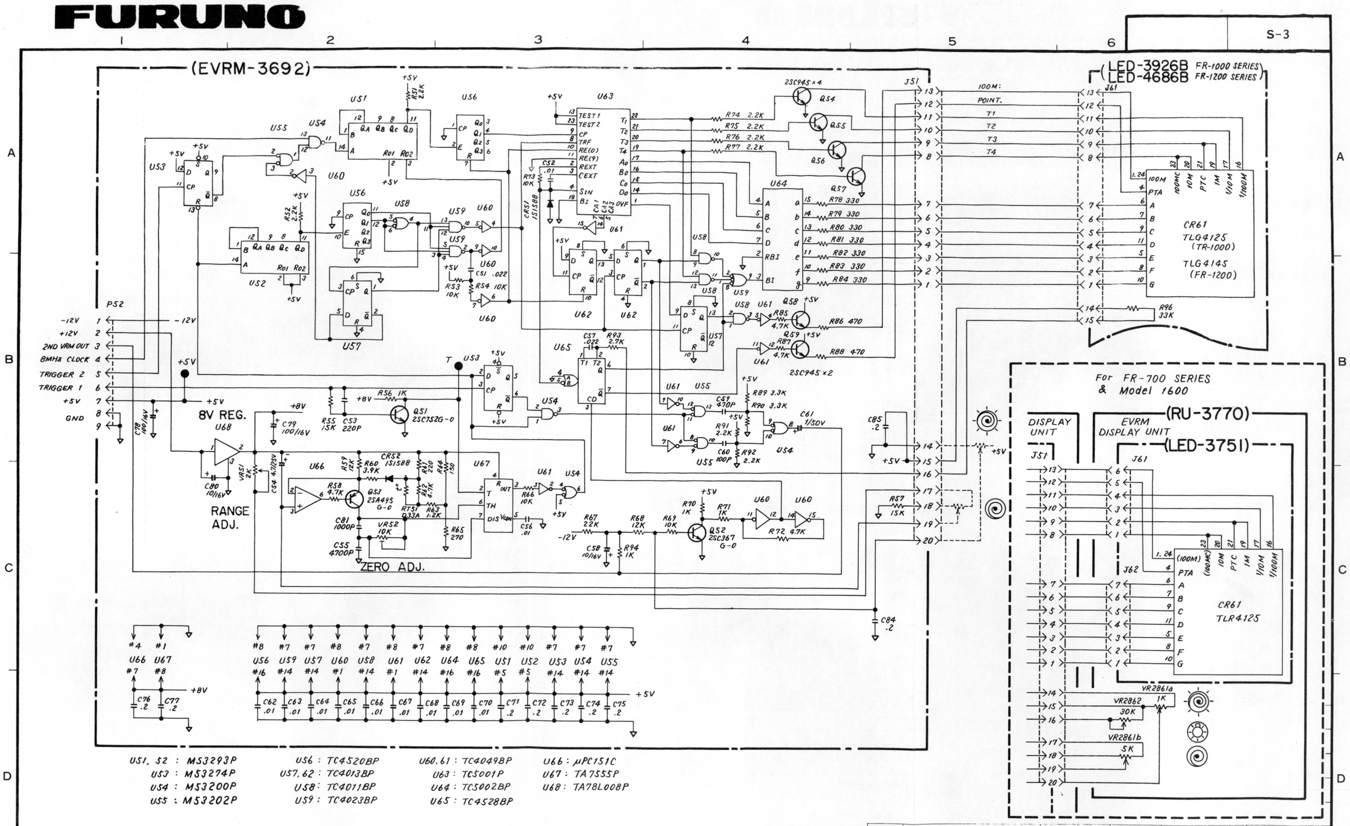
承認 APPROVED	MAY. 31. '79	三角法 THIRD ANGLE PROJECTION		名称 TITLE	INTERFERENCE REJECTOR 干渉除去回路 IR-3695
検図 CHECKED	MAY. 31. '79	尺度 SCALE	/		
製図 DRAWN	31. MAY. 79 K. Murakami	重量 WEIGHT	kg	図番 DWG. NO.	C3237-012-H

Rev.: 12/81, 5/82, 5/83

FURUNO ELECTRIC CO., LTD.

FURUNO

S-3



(EVRM-3692)
LED-3926B FR-1000 SERIES
LED-4686B FR-1200 SERIES
CR61 TLG4125 (TR-1000) TLG4145 (FR-1200)
For FR-700 SERIES & Model 1600
(RU-3770)
DISPLAY UNIT
EVRM DISPLAY UNIT
(LED-3751)
CR61 TLR4125
PS2
-12V 1
+12V 2
2ND VRM OUT 3
8MHz CLOCK 4
TRIGGER 2 5
TRIGGER 1 6
+5V 7
GND 8
9
8V REG.
U68
RANGE ADJ.
ZERO ADJ.
J51
J61
J62
100M:
POINT.
T1
T2
T3
T4
2SC945×4
2SC945×2
+8V
+5V

U51, 52 : M53293P
U53 : M53274P
U54 : M53200P
U55 : M53202P

U56 : TC4520BP
U57, 62 : TC4013BP
U58 : TC4011BP
U59 : TC4023BP

U60, 61 : TC4049BP
U63 : TC5001P
U64 : TC5002BP
U65 : TC4528BP

U66 : μPC151C
U67 : TA7555P
U68 : TA78L008P

NOTE: 1. ADD 2800 TO SYMBOL NUMBERS.
部品番号は 2800 を加えて読む。

2. ALL RESISTANCE IN OHMS, 1/4W, AND CAPACITANCE IN MICROFARADS UNLESS NOTED OTHERWISE.
特記なき抵抗の単位は全てΩ, 1/4W 又コンデンサはμF。

FR-360 II
FR-240 III
MODEL 2400
MODEL 1600
(NO.1 EVRM)

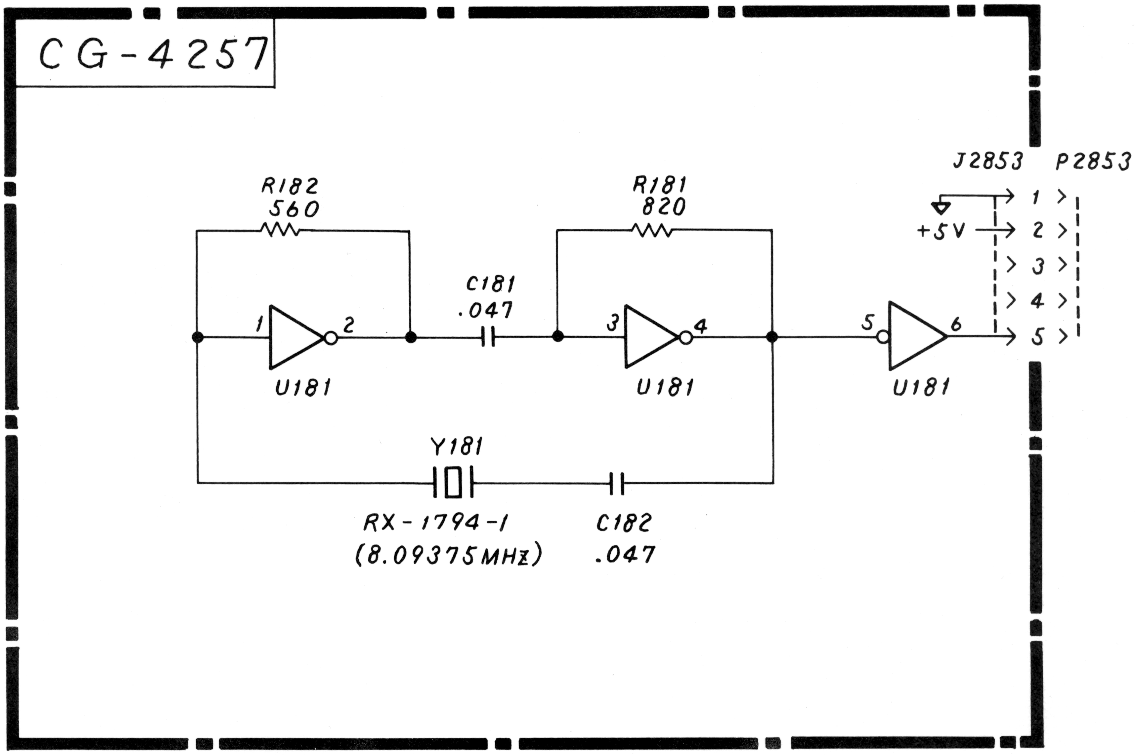
FR-700/1000/1200
SERIES
(NO.2 EVRM)

品番 ITEM	品名 NAME	材質 MATERIAL	数量 Q'TY	図番 DWG.NO.	摘要 REMARKS

承認 APPROVED	MAY.31.'79	三角法 THIRD ANGLE PROJECTION		名称 TITLE	E.V.R.M. 可変距離環装置
検図 CHECKED	MAY.31.'79	尺度 SCALE	/		
製図 DRAWN	31.MAY.79 K. Kusun	重量 WEIGHT	kg	図番 DWG.NO.	C3237-011-E

REV.: 5/83

FURUNO ELECTRIC CO., LTD.


CG-4257
R182
560
R181
820
C181
.047
1
2
3
4
5
6
U181
U181
U181
J2853
P2853
+5V
1
2
3
4
5
Y181
RX-1794-1
(8.09375MHz)
C182
.047

U181 : M74LS04P

NOTE : 特記なき抵抗の単位は全てΩ, 1/4W,
ヌ、コンデンサはμF。
ALL RESISTANCE IN OHMS, 1/4W, AND
CAPACITANCE IN MICROFARADS UNLESS
NOTED OTHERWISE.

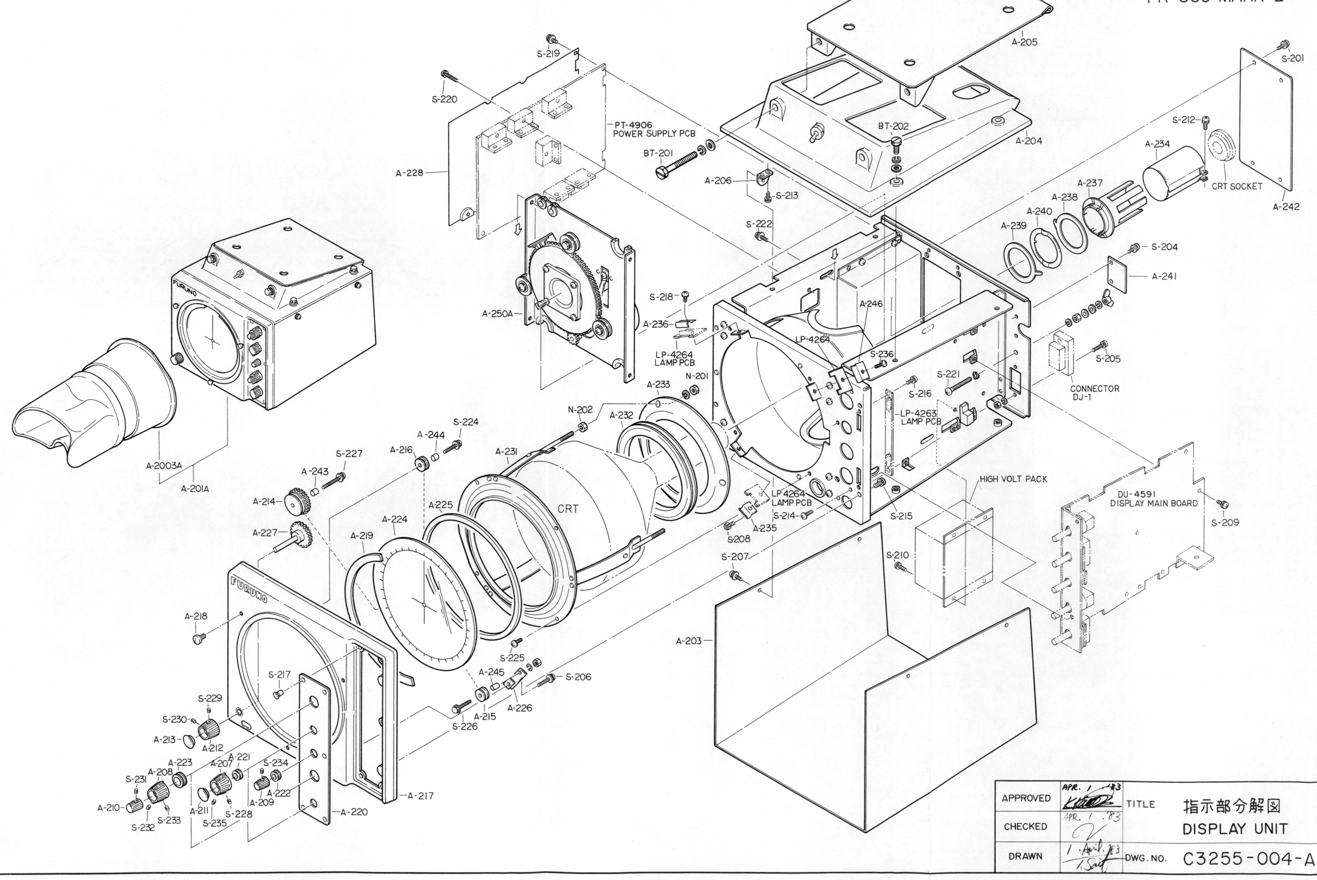
MODEL 2400
FR-240 MK-Ⅲ
FR-360 MK-Ⅱ

品番 ITEM	品 名 NAME	材 質 MATERIAL	数 量 Q'TY	図 番 DWG. NO.	摘 要 REMARKS

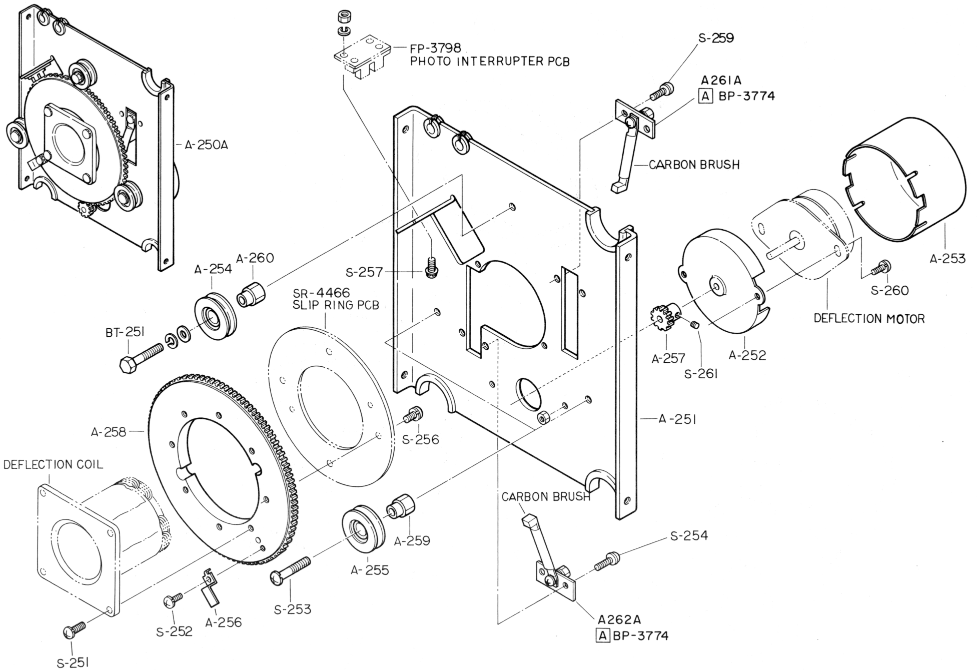
承認 APPROVED	JUN. 8. '83	三角法 THIRD ANGLE PROJECTION	名称 TITLE CG-4257 8MHz クロック基板回路図 8MHz CLOCK BOARD
検図 CHECKED	JUNE 8. '83	尺度 SCALE	
製図 DRAWN	June 6. '83	重量 WEIGHT kg	図番 DWG. NO. C3255-006-A

FURUNO ELECTRIC CO., LTD.

MODEL 2400
FR-240 MARK-Ⅲ
FR-360 MARK-Ⅱ


A-205
S-219
S-220
S-201
PT-4906
POWER SUPPLY PCB
A-204
S-212
BT-202
A-234
BT-201
A-237
CRT SOCKET
A-228
A-206
S-213
A-238
A-242
A-240
S-222
A-239
S-204
A-241
A-250A
S-218
A-246
A-236
LP-4264
LAMP PCB
LP-4264
S-236
S-205
N-201
CONNECTOR
DJ-1
A-233
S-221
N-202
A-232
S-216
LP-4263
LAMP PCB
S-224
A-244
A-216
A-231
S-227
A-243
CRT
LP4264
LAMP PCB
HIGH VOLT PACK
DU-4591
DISPLAY MAIN BOARD
A-2003A
A-201A
A-214
A-225
S-214
S-215
S-209
A-224
A-235
A-227
A-219
S208
S-207
S-210
A-218
A-203
S-225
A-245
S-206
S-217
A-226
A-215
S-229
S-226
S-230
A-213
A-212
A-223
A-221
S-234
A-208
A-207
S-231
A-222
A-209
A-217
A-210
A-211
S-228
S-233
S-235
A-220
S-232

APPROVED	APR. 1 .'83 K.	TITLE	指示部分解図 DISPLAY UNIT
CHECKED	APR. 1 .'83		
DRAWN	1. April. '83 I. Sait	DWG. NO.	C3255-004-A

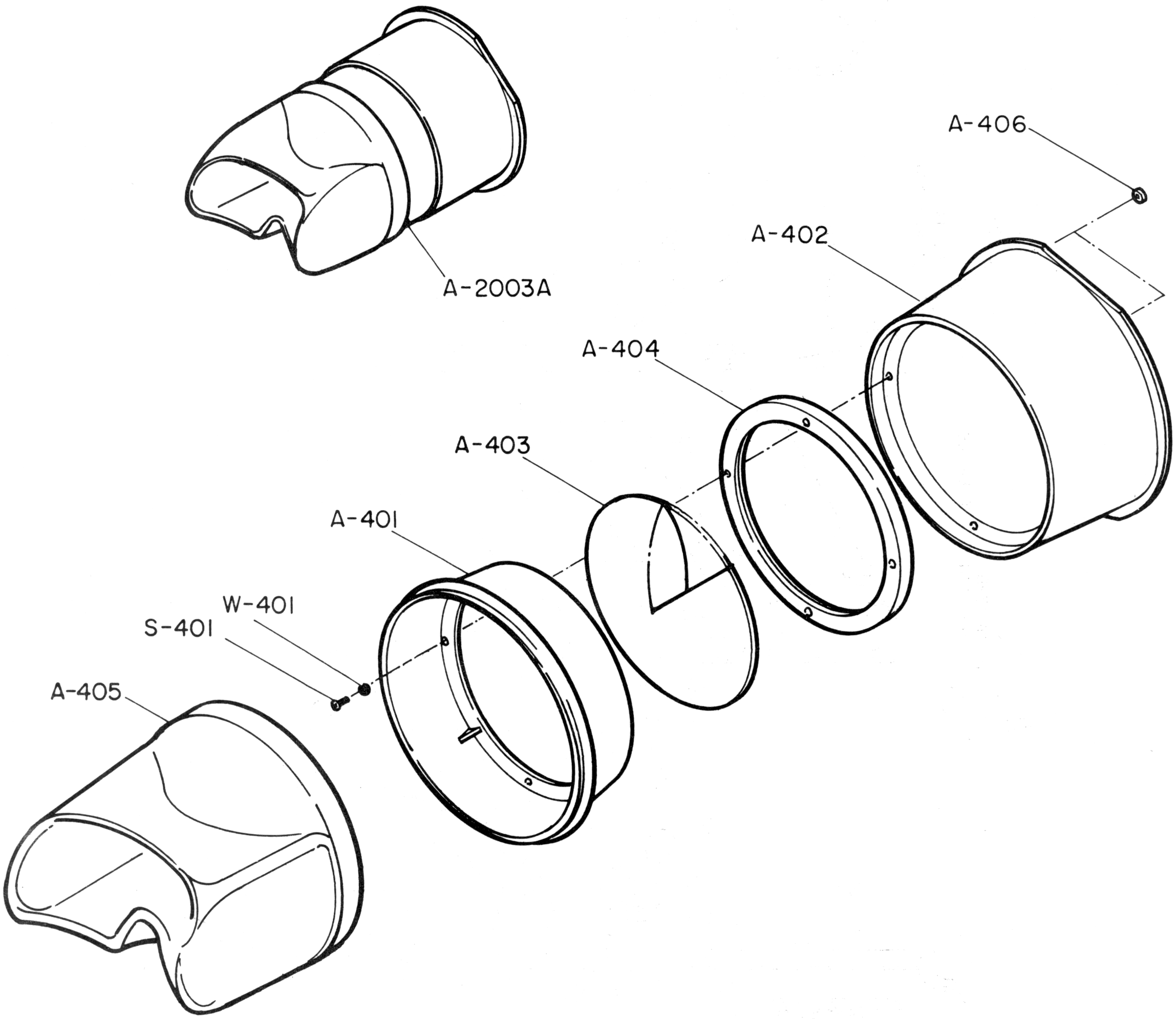

FP-3798
PHOTO INTERRUPTER PCB
S-259
A261A
A BP-3774
A-250A
CARBON BRUSH
A-253
A-254
A-260
S-257
S-260
SR-4466
SLIP RING PCB
DEFLECTION MOTOR
BT-251
A-257
A-252
S-261
A-258
S-256
A-251
DEFLECTION COIL
CARBON BRUSH
A-259
S-254
A-255
S-253
A-256
S-252
A262A
A BP-3774
S-251

MODEL 2400
FR-240 MARK-III
FR-360 MARK-II

APPROVED	APR. 1. '83	TITLE	偏向テーブル分解図 DEFLECTION TABLE ASSY
CHECKED			
DRAWN		DWG. NO.	C3255-003-A

D-3

MODEL 1600
MODEL 2400
FR-240 MARK-Ⅲ
FR-360 MARK-Ⅱ


A-2003A
A-406
A-402
A-404
A-403
A-401
W-401
S-401
A-405

品番 ITEM	品名 NAME	材質 MATERIAL	数量 Q'TY	図番 DWG. NO.	摘要 REMARKS

承認 APPROVED	JUL. 23. '81	三角法 THIRD ANGLE PROJECTION		名称 TITLE	フード部分解図 VIEWING HOOD ASSEMBLY
検図 CHECKED	JULY. 22. '81	尺度 SCALE	/		
製図 DRAWN	22nd. July. 1981	重量 WEIGHT	kg	図番 DWG. NO.	C3248-006-B

FURUNO ELECTRIC CO., LTD.

PART 2

SCANNER UNIT

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- 1-4. Bearing Signal Generator 1-6

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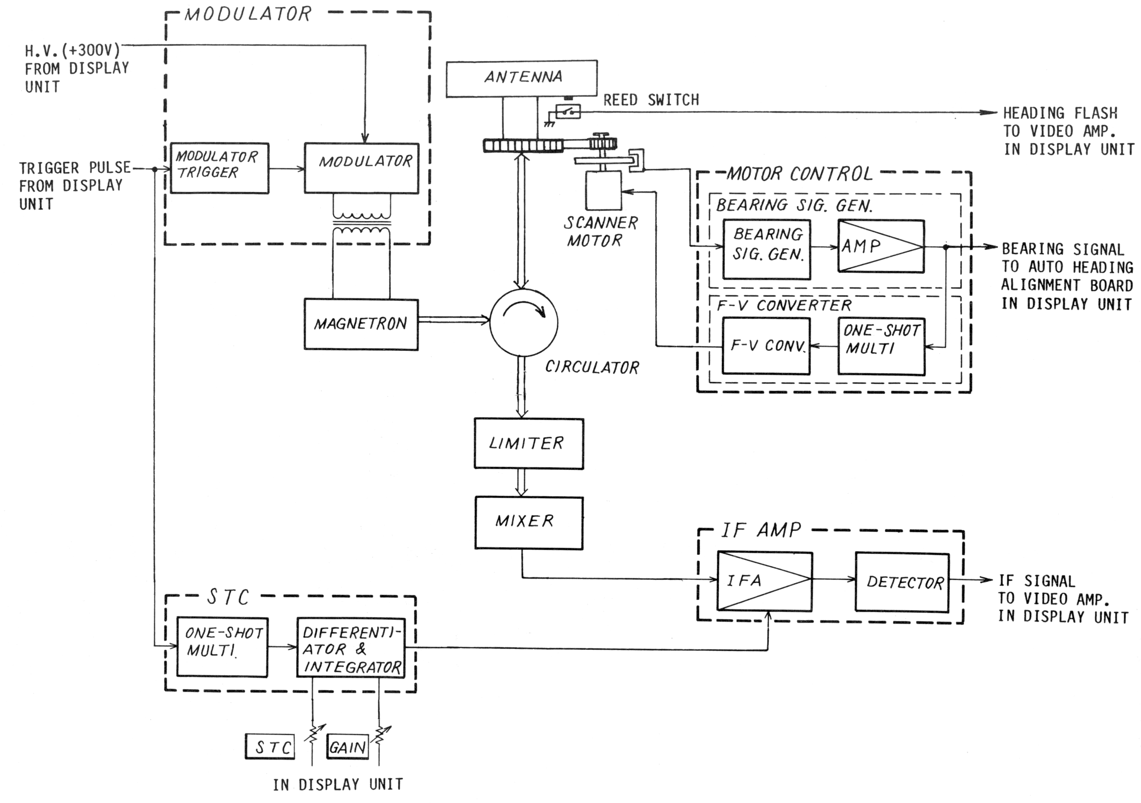
ELECTRICAL PARTS LIST P-1 & P-2

MECHANICAL PARTS LIST P-3 & P-4

SCHEMATIC DIAGRAM S-1

MECHANICAL PARTS EXPLODED VIEW D-1 & D-2


MODULATOR
H.V.(+300V) FROM DISPLAY UNIT
TRIGGER PULSE FROM DISPLAY UNIT
MODULATOR TRIGGER
MODULATOR
MAGNETRON
ANTENNA
REED SWITCH
HEADING FLASH TO VIDEO AMP. IN DISPLAY UNIT
SCANNER MOTOR
MOTOR CONTROL
BEARING SIG. GEN.
BEARING SIG. GEN.
AMP
BEARING SIGNAL TO AUTO HEADING ALIGNMENT BOARD IN DISPLAY UNIT
F-V CONVERTER
F-V CONV.
ONE-SHOT MULTI
CIRCULATOR
LIMITER
MIXER
IF AMP
IFA
DETECTOR
IF SIGNAL TO VIDEO AMP. IN DISPLAY UNIT
STC
ONE-SHOT MULTI
DIFFERENTI-ATOR & INTEGRATOR
STC
GAIN
IN DISPLAY UNIT

FURUNO

承認 APPROVED	· ·
検図 CHECKED	· ·
製図 DRAWN	· ·
三角法 THIRD ANGLE PROJECTION	
尺度 SCALE	
重量 WEIGHT	kg
名称 TITLE	MODEL 2400 BLOCK DIAGRAM OF SCANNER UNIT
図番 DWG.NO.	0-1

品番 ITEM	品名 NAME	材質 MATERIAL	数量 Q'TY	図番 DWG.NO.	摘要 REMARKS

FURUNO ELECTRIC CO., LTD.

CHAPTER 1. CIRCUIT DESCRIPTION

1-1. Modulator

The modulator comprises a modulator trigger generator and a modulator. Its schematic diagram is shown in Fig.1-1.

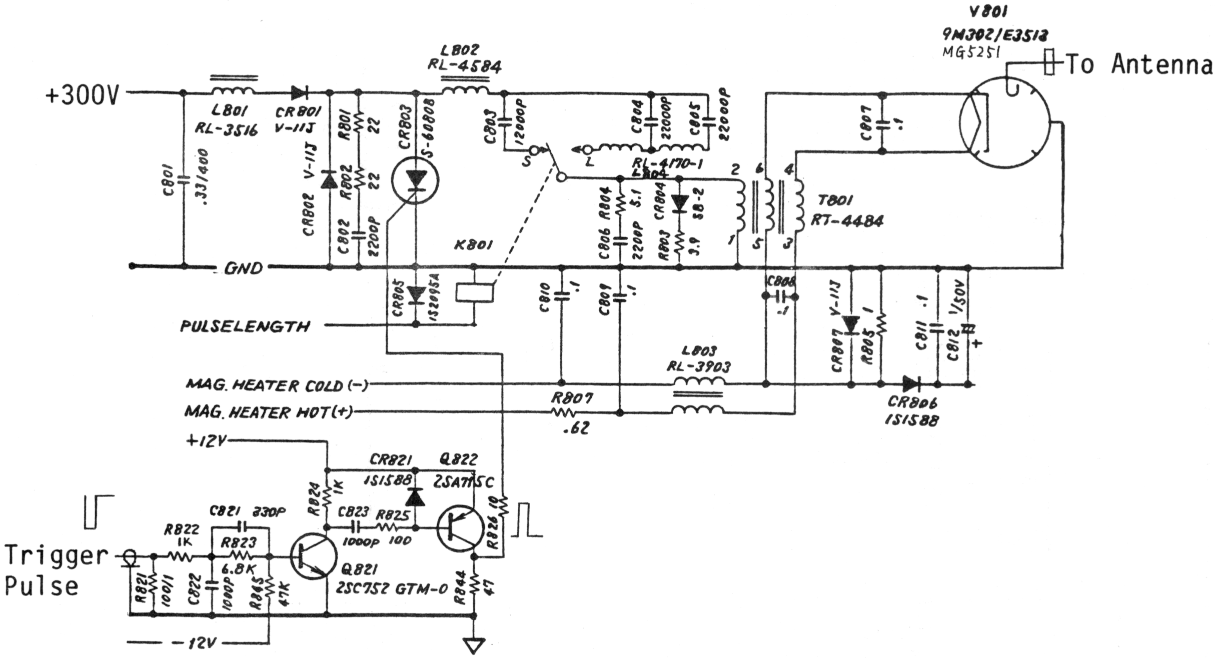

V801
9M302/E3512
MG5251
To Antenna
+300V
L801
RL-3516
CR801
V-11J
C801
.33/400
CR802
V-11J
R801
22
R802
22
C802
2200P
CR803
S-6080B
L802
RL-4584
C803
12000P
S
L
C804
22000P
C805
22000P
RL-4170-1
L804
R804
5.1
C806
2200P
CR804
SB-2
R803
3.9
K801
2
6
4
1
5
3
T801
RT-4484
C807
.1
GND
CR805
1S2095A
PULSELENGTH
C810
.1
C809
.1
C808
.1
CR807
V-11J
R805
1
C811
.1
C812
1/50V
+
L803
RL-3903
MAG. HEATER COLD (−)
MAG. HEATER HOT (+)
R807
.62
CR806
1S1588
+12V
CR821
1S1588
Q822
2SA715C
R824
1K
C821
330P
C823
1000P
R825
100
R826
10
R822
1K
R823
6.8K
Trigger
Pulse
R821
100/1
C822
1000P
R845
47K
Q821
2SC752 GTM-0
R844
47
−12V

Fig.1-1 Modulator Circuit

Modulator Trigger Generator

The modulator trigger generator is composed of Q821, Q822 and associated components. Receiving the trigger pulse from the trigger generator in the display unit, it produces gate trigger pulse to fire the SCR CR803 in the modulator.

In Fig.1-1, Q821 receives the trigger pulse from the display unit through R822, R823 and C821. With Q821 turned on, Q822 base current flows through R825, C823 and Q821. Then, Q822 conducts and a positive going gate trigger pulse is delivered to the gate of the SCR CR803. Since the time constant of C823 and R825 is comparatively small and C823 is charged to saturation in a very short time, the gate trigger pulse obtained is narrow as shown in Fig.1-2. With Q821 cut off, C823 is discharged thru R825, CR821 and R824.

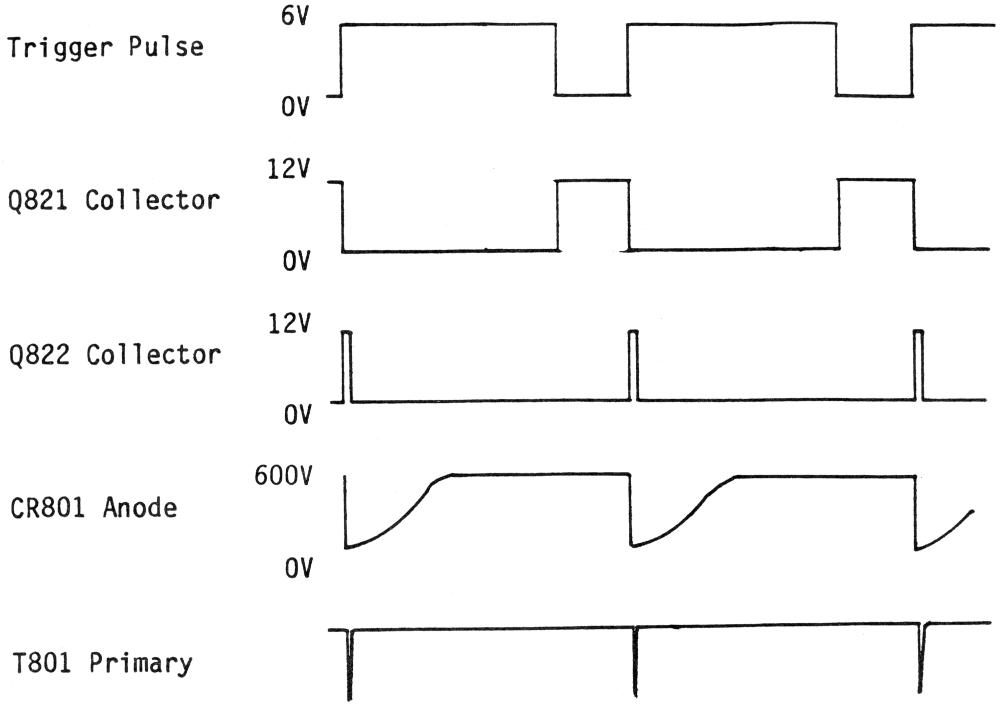


Fig.1-2

Modulator

The modulator supplies a narrow high tension pulse to the magnetron V801; the pulselength is 0.08 microseconds on ¼, ½ and 1-½ n.m. ranges and 0.5 microseconds on the other ranges.

The +300V power applied to the modulator is doubled by the electromotive force developed across the charging choke L801, and about 600V induced at the anode of CR801 charges the pulser capacitors C803/C804/C805 in the pulse forming network C803/C804/C805/L804. The charging speed of the pulser capacitors is determined by the series resonance circuit composed of L801 and the pulse forming network, and time to full charge is roughly given by the equation $T = \pi\sqrt{L \times C}$, where L represents L801 and C, capacitors C804 and C805 in long range and C803 in short range.

CR801 prevents the energy stored in the pulse forming network from discharging to the +300V line.

With CR803 fired by the positive going pulse derived from Q822 collector, whole energy in the pulse forming network is rapidly discharged through L802, CR803 and the primary of the pulse transformer T801.

Since the characteristic impedance of the pulse forming network and the primary winding of T801 is matched, a half of the network voltage is developed across the T801 primary winding. The voltage across the transformer primary winding (Primary to secondary winding ratio is 1 to 15.) is boosted up to 4.7KV and applied to the cathode of the magnetron.

Function of diode CR802 is as follows.

If the modulator load does not match the network impedance, there will be reflected inverse voltage remaining in the network capacitors after the discharging cycle. At the end of the next charging cycle, the network will be charged to normal voltage level but less the reflected voltage. The action is cumulative and the reflected voltage could cause erratic operation or damage to modulator and transmitter components. The diode CR802 shunts the pulse forming network to prevent the inverse voltage built up across the network.

Due to the time lag between application of the pulse and the time it takes the magnetron to draw current, a spike is produced. R804 and C806 are connected as a load circuit for the modulator. This CR network slows down the rate of rise of the modulator output pulse and prevents the development of spike.

CR804 absorbs the counter electromotive force that is developed at the moment CR803 turns off, protecting CR803 from damage.

The coil L802 helps to hold off the discharge current until CR803 is brought to fully conducting state.
As soon as CR803 is fired, its anode voltage falls rapidly to zero and discharge current from the pulse forming network begins to flow at a slow rate due to the relatively high inductance value of L802. After a certain period of time, L802 saturates and inductance falls rapidly to a negligible value so that the large amount of discharge current may flow.

R801, R802 and C802 are to protect CR803 from failure due to transient voltage.

1-2. Duplexer and Mixer

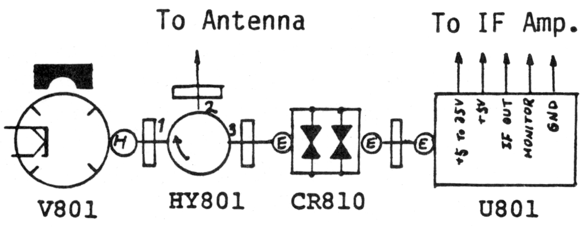


Fig.1-3

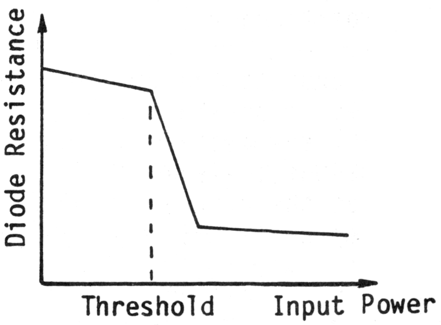


Fig.1-4 PIN Diode Characteristic

Since the radar system uses a single antenna for transmission and reception, an efficient device is required for switching the transmitter and receiver. This radar employs circulator HY801 for this purpose. The circulator HY801 is a passive directional coupler with three ports.

It contains a permanent magnet and a core of ferrite material and bends the electromagnetic force in a specific direction. In Fig.1-3, the microwave energy produced by the magnetron enters the circulator from port 1. It is bent in the direction of the arrow and emerges from port 2 with little loss, port 3 being isolated. In the same manner, the received signal entering into port 2 is transferred to port 3, isolating port 1. This operation of the circulator protects the receiver during transmission and minimizes loss of the received signal during reception.

The diode limiter CR810 is a self-activating switch made of a PIN diode and a varactor diode. Its function is to attenuate strong transmission signal of other boat radars that may enter from the antenna and to protect diodes in the mixer circuit. The PIN diode has a characteristic as in Fig.1-4 and conducts at a certain level of microwave power.

When the diode is in cut-off state, the input impedance of the diode limiter matches the characteristic impedance of the waveguide and the microwave energy is delivered to the mixer circuit. When the diode is in conductive state, the waveguide is short-circuited and most of the input energy is reflected back to the transmitter side. The strong signal thus attenuated is further weakened down to about 150mW by a varactor diode.

U801 is a microwave IC (MIC) incorporating a local oscillator and mixer diodes. The received microwave signal coming from the diode limiter is mixed with the local oscillation signal in the mixer diodes and converted to IF signal of 40MHz.

1-3. STC Circuit

The STC circuit made up of U603, Q606 and Q607 changes the gain of IF amplifier with respect to time so that the gain is minimum at the time of transmission and increases gradually to maximum gain.

Input to the STC circuit is the trigger pulse derived from the trigger generator in the display unit. One-shot multivibrator U603 is triggered by the positive going edge of the trigger pulse and produces a pulse of 240us, driving Q607 into conduction. The positive going pulse output at the emitter of Q607 is differentiated by C655 and R640; the negative spike of the resultant waveform is removed by CR608.

The CR network consisting of C656/R641 and C657/R642 is an integrator, each couple having a specific time constant. The network compensates for the differentiator output waveform so that the slower decrease curve may result at the anode of CR609. STC control VR601b slices the compensated waveform at the part below the anode voltage of CR608. Q608 amplifies the resultant waveform and supplies its output to the IF amplifier to suppress the gain. The gain reduction in the IF amplifier is proportional to the amplitude of the waveform, that is the gain is minimum at the time of transmission and gradually restores to the level set by GAIN control VR601a.

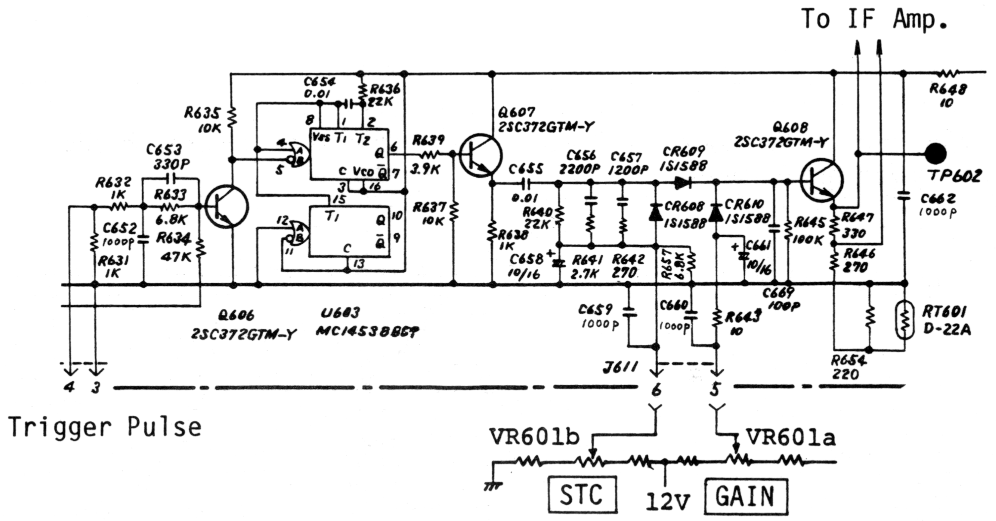

To IF Amp.
R635 10K
C654 0.01
R636 22K
C653 330P
R632 1K
R633 6.8K
C652 1000P
R634 47K
R631 1K
Q606 2SC372GTM-Y
U603 MC14538BCP
T1 T2
Vss
Q
C Vco Q̄
R639 3.9K
R637 10K
Q607 2SC372GTM-Y
C655 0.01
C656 2200P
C657 1200P
CR609 1S1588
CR608 1S1588
CR610 1S1588
R638 1K
R640 22K
C658 10/16
R641 2.7K
R642 270
R657 6.8K
C661 10/16
Q608 2SC372GTM-Y
R645 100K
R647 330
R646 270
R648 10
TP602
C662 1000P
C659 1000P
C660 1000P
R643 10
C669 100P
RT601 D-22A
R654 220
J611
4 3
6 5
Trigger Pulse
VR601b
VR601a
STC
12V
GAIN

Fig.1-5 STC Circuit

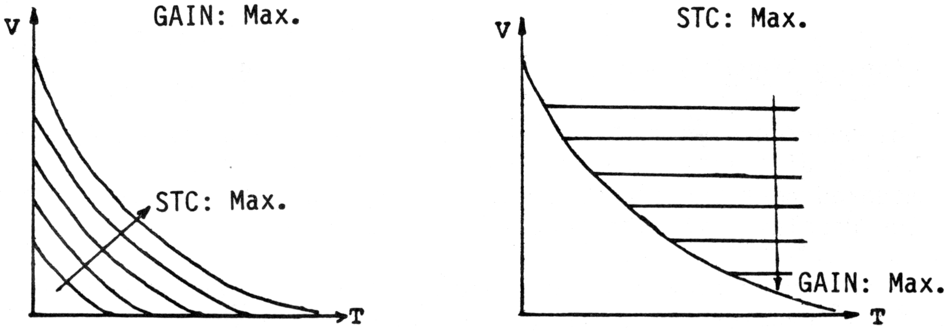


Fig.1-6 Waveform on TP602

How the STC waveform changes with the STC control setting is shown in Fig.1-6.

The GAIN control VR601a changes the base potential of Q608, emitter current of Q608 and accordingly the IF amplifier gain.

1-4. Motor Control Circuit

The motor control circuit comprises a bearing signal generator and an F-V converter as shown in Fig.1-7.

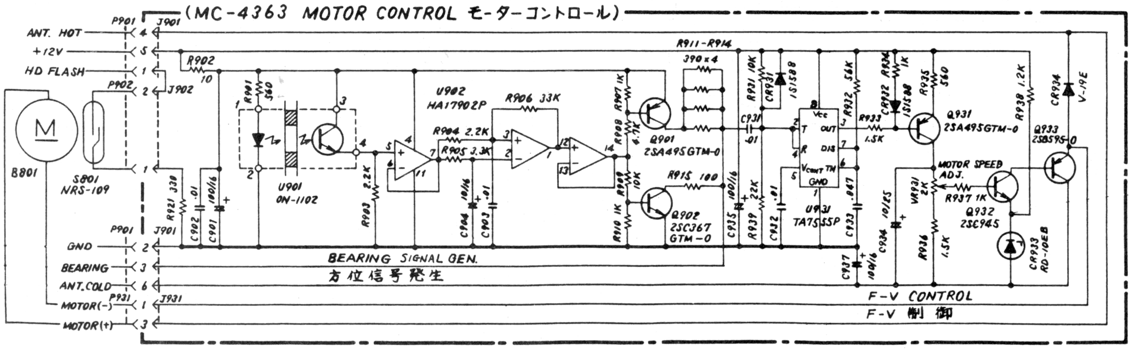

(MC-4363 MOTOR CONTROL モーターコントロール)
ANT. HOT
+12V
HD FLASH
GND
BEARING
ANT.COLD
MOTOR(-)
MOTOR(+)
P901
J901
P902
J902
P931
J931
B801
S801
NRS-109
R902
10
R921 330
C902 .01
C901 100/16
R901 560
U901
ON-1102
R903 2.2K
U902
HA17902P
R904 2.2K
R905 3.3K
R906 33K
C904 10/16
C903 .01
R907 1K
R908 4.7K
R909 10K
R910 1K
Q901
2SA495GTM-0
Q902
2SC367
GTM-0
R911-R914
390×4
R915 100
C935 100/16
C931
.01
R931 10K
CR931
1S1588
R939 22K
C932 .01
Vcc
T
R
Vcont
GND
OUT
DIS
TH
U931
TA7555P
R932 56K
C933 .047
C937 100/16
R933
1.5K
CR932
1S1588
R934 1K
R935 560
Q931
2SA495GTM-0
MOTOR SPEED
ADJ.
VR931
2K
C934 10/25
R936 1.5K
R937 1K
Q932
2SC945
R938 1.2K
Q933
2SB595-0
CR933
RD-10EB
CR934
V-19E
BEARING SIGNAL GEN.
方位信号発生
F-V CONTROL
F-V 制御

Fig.1-7 Motor Control Circuit

Bearing Signal Generator

The bearing signal generator senses the antenna speed by means of a timing disc fitted on the scanner motor shaft and a photo interrupter mounted near the timing disc, and synchronizes the sweep rotation in the display unit with that of the antenna.

Photo interrupter U901 is composed of a light emitting diode and a photo transistor. It has a configuration in the shape of "U". The light emitting diode is mounted in a wall of "U" shape and the photo transistor in the other wall. Between the two walls is a slit where the timing disc is inserted.

The timing disc is perforated 90 holes at regular intervals along its circumference and rotates at a speed of 120 rpm. The photo transistor receives light emitted by the light emitting diode thru a hole of a timing disc and converts it into electric current. The output of photo transistor across R903 represents a half-rectified sine wave with a frequency of 180Hz. This signal is amplified, reshaped and then sent to the display unit to drive the deflection coil drive motor.

F-V Converter Circuit

The F-V converter is made up of U931, Q931, Q932 and Q933.

It maintains the scanner motor at a constant speed by converting the motor speed into a dc voltage and controlling the current flowing into the motor.

U931 is a timer IC, which works in the same manner as ordinary one-shot multivibrator. Activated by every negative going edge of the bearing signal at trigger pin "T", it produces a positive going pulse at pin "3" with a length determined by R932/C933. Since the length of the pulse is always constant, duty ratio of "H" and "L" at the base of Q931 changes as shown in Fig.1-8, depending on the frequency of the bearing signal. This change in duty ratio leads to the change in dc voltage at the collector of Q931. That is, if the frequency of the bearing signal increases, the collector voltage drops, causing decrease in the base current of Q932/Q933 and resultantly the decrease in the current flowing into scanner motor B801. On the contrary, if the frequency decreases, the collector voltage rises and the current flowing into B801 increases.

In this manner, motor B801 is maintained at a constant speed set by VR931.

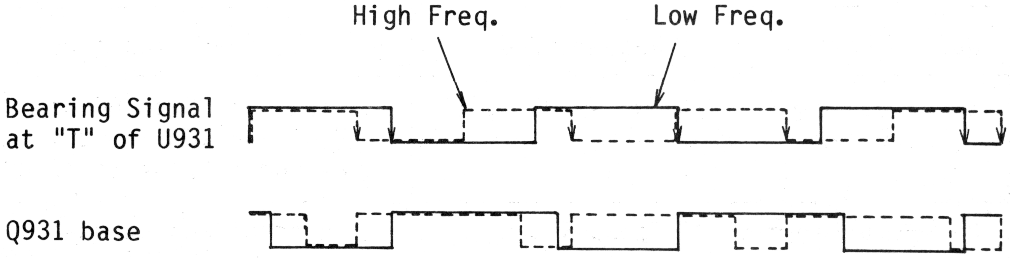


Fig.1-8

CHAPTER 2. ADJUSTMENT

2-1. General

This chapter provides adjustments of scanner unit in a work shop where various measuring instruments are available.

The adjustments and checks described in this chapter are based on the standard procedure employed at Furuno factory. The necessary test instruments are shown in Table 2-1.

Table 2-1 Measuring Instruments

No.	Name	Recommended	Specifications
1	Frequency Counter	Iwatsu UC-7641	Freq. : DC to 60MHz Vin : 10mV to 20V Period : 0.1us to 10,000s
2	Multimeter	Sanwa K-30D	Internal Resistance 10,000 ohms/VDC 5,000 ohms/VAC
3	Non-reflection Termination	Furuno	

2-2. Motor Speed (Bearing Signal Frequency)

Necessary Test Instrument: Frequency Counter

Rating: 180Hz + 2Hz

Condition: Stand-by, 1/4 n.m. range

Procedure:

1) Connect the check probe of frequency counter between pin #2 and #3 of J901. See Fig.2-1 and Fig.5-2.

2) Operate the radar in the above condition. Confirm that the antenna radiator is rotating.

3) Adjust VR931 so that the frequency counter indicates 180Hz.

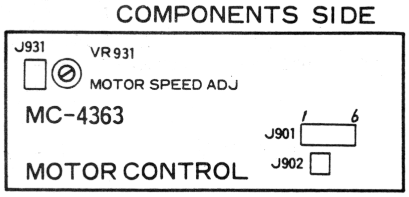


Fig.2-1

2-3. Magnetron Current

Necessary Test Instrument: Multimeter

Rating: Short Ranges (1/4 n.m. range) ----- 1.3V to 2.4V
Long Ranges (24 n.m. range) ------- 1.8V to 2.4V

Condition: Transmission

Procedure:

1) Connect the multimeter, set to DC10V range, to the pin #3 (+) and #5 (-) of J801. See Fig.5-1.

2) Operate the radar for transmission on 1/4 n.m. range.

3) Confirm that the magnetron current is within the rating. (1.3V to 2.4V)

4) Set the RANGE switch to 24 n.m. range to confirm that the current is within the rating. (1.8V to 2.4V)

If the current is far out of the range specified above, the magnetron is suspicious of fault.

2-4. Timing Belt Tension

Necessary Test Instrument: Tension Gauge
(Spring Type, Max. tension: 10 Kg)

Procedure:

1) Loosen three screws S-106 shown in Fig.2-2.

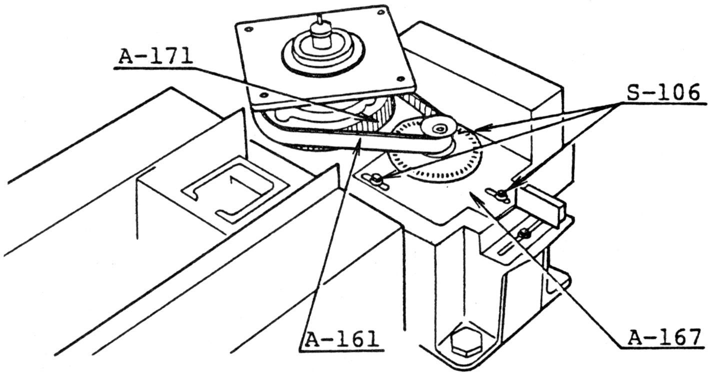
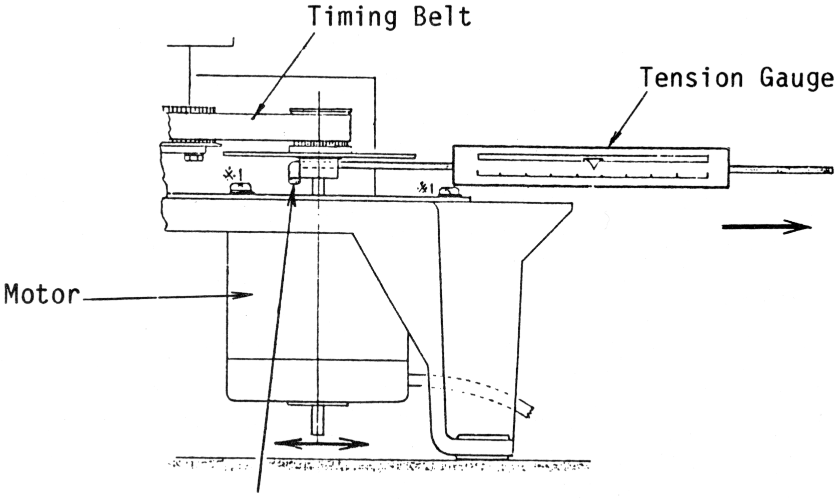

A-171
S-106
A-161
A-167

Fig.2-2

2) Hook the tension gauge to the motor shaft as shown in Fig.2-3.


Timing Belt
Tension Gauge
Motor
*1
*1

Hook the tension gauge.

Fig.2-3

3) Pull the gauge until the reading reaches 5kg.

4) Loosen the tension gauge for 2.2kg thru 2.4kg. Then, tighten screws S-106.

TEST CABLE FOR RF TRANSCEIVER MODULE CHECKING

No.	Name	Code No.	Type	Q'ty
1	24P Plug	000-500-160 000-500-150 000-500-162	MCP-24M02 (HOUSING) MCP-24WS2 (HOUSING) MCP-M102R (CONTACT)	1 1 20
2	12P Plug	000-505-460 000-505-495	LP-12 (HOUSING) LLF-01T-2.0 (CONTACT)	1 11
3	15P Plug	000-505-461 000-505-495	LP-15 (HOUSING) LLF-01T-2.0 (CONTACT)	1 13
4	Coax. Cable & Lead Wires		Use a scrap of interconnection cable.	Some

NOTE: 1) Do not place the RF transceiver assembly on the steel desk with the magnetron side down, otherwise it may be deteriorated.
2) Do not operate the RF transceiver module in TRANSMIT condition without connecting the NON-REFLECTION TERMINATION.

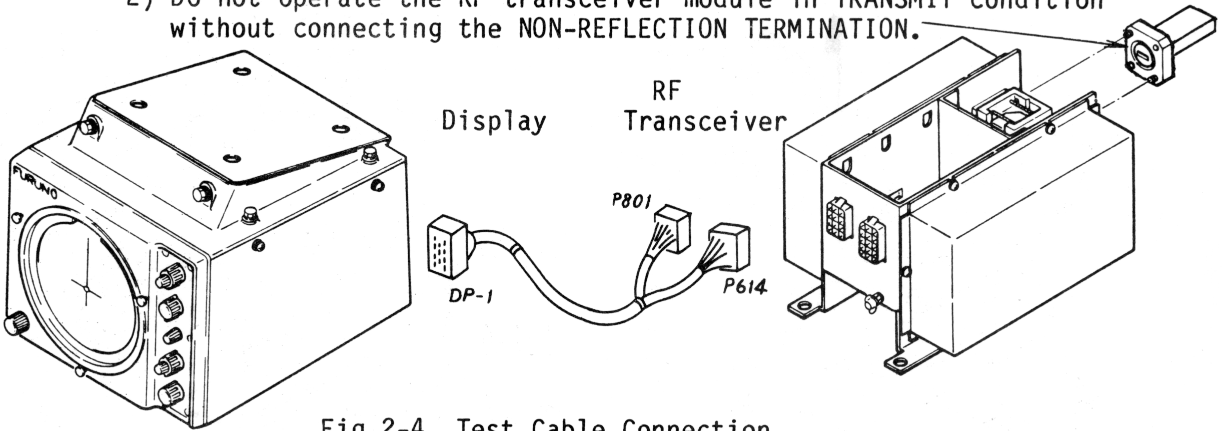

FURUNO
Display
RF Transceiver
P801
DP-1
P614

Fig.2-4 Test Cable Connection

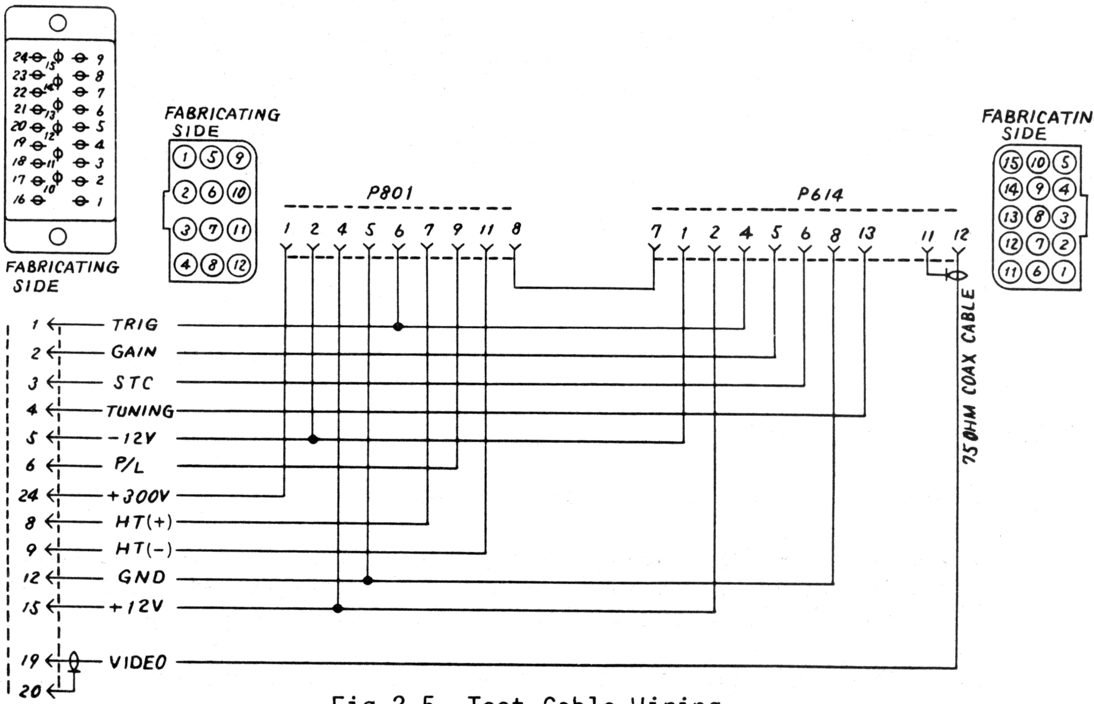

DP-1
24 15 9
23 14 8
22 7
21 13 6
20 12 5
19 4
18 11 3
17 10 2
16 1
FABRICATING SIDE
FABRICATING SIDE
1 5 9
2 6 10
3 7 11
4 8 12
P801
1 2 4 5 6 7 9 11 8
P614
7 1 2 4 5 6 8 13 11 12
FABRICATING SIDE
15 10 5
14 9 4
13 8 3
12 7 2
11 6 1
1 TRIG
2 GAIN
3 STC
4 TUNING
5 -12V
6 P/L
24 +300V
8 HT(+)
9 HT(-)
12 GND
15 +12V
19 VIDEO
20
75 OHM COAX CABLE

Fig.2-5 Test Cable Wiring

CHAPTER 3. REMOVAL AND REPLACEMENT OF MAJOR COMPONENTS

Refer to Dwg.Nos.C3248-008 and C3248-009 on pages D-1 and D-2, respectively.

3-1. Radiator Assembly A-130A

1) Unfasten four fixing bolts A-147, and remove the radome upper assembly A-120A. See Fig.3-1.

2) Unfasten four M5x25 hex. bolts BT-104 by a wrench, and lift the radiator assembly A-130A up carefully. See Fig.3-2.

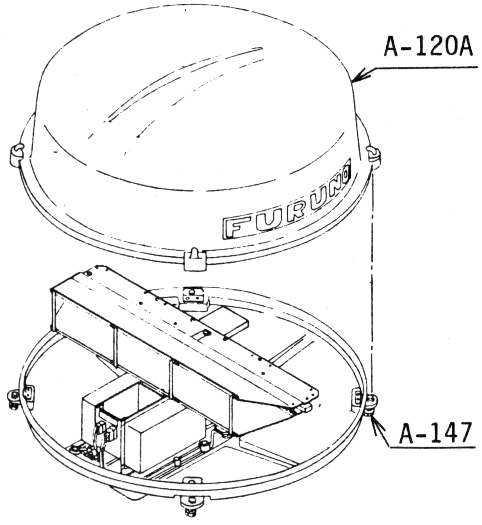


Fig.3-1

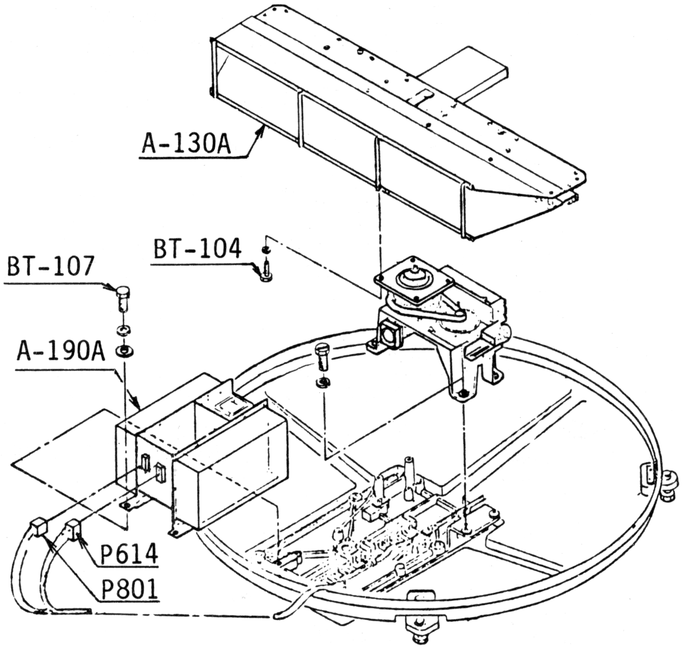


Fig.3-2

3-2. Timing Belt A-161

1) Remove the radiator assembly A-130A.

2) Loosen three M4x10 washer head screws S-106 and slide the motor fixing plate A-167 toward the idle pulley A-171, and tension of the timing belt is slacken. Take out the timing belt. See Fig.3-3.

NOTE: When refitting the timing belt, tension adjustment is required. Refer to page 2-3.

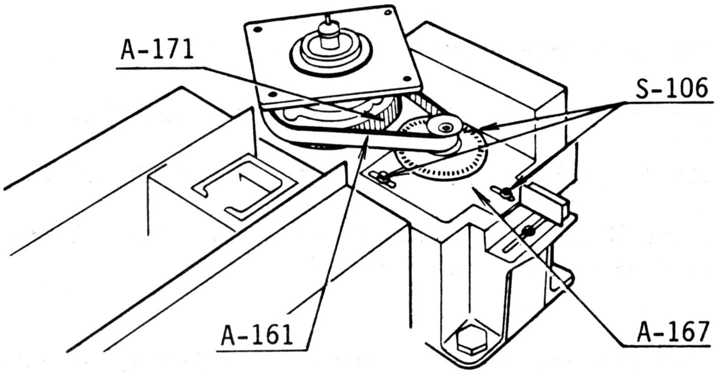

A-171
S-106
A-161
A-167

Fig.3-3

3-3. Scanner Motor B801

1) Remove the timing belt A-161. See Fig.3-3.

2) Remove the motor fixing plate A-167 on which MC-4363 MOTOR CONTROL board and the scanner motor are mounted. See Fig.3-3 above.

3) Unscrew two M4x5 setscrews S-115 and S-116, and the timing disk with drive gear A-168 comes out.

4) Disconnect the plug P931 on the MOTOR CONTROL board.

5) Unscrew three M4x10 washer head screws S-113, and the scanner motor comes free.

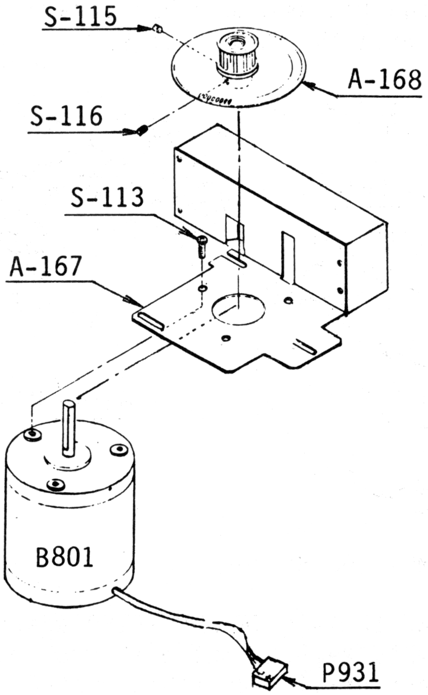

S-115
A-168
S-116
S-113
A-167
B801
P931

Fig.3-4

3-4. RF Transceiver Assembly A-190A

1) Remove the radome upper assembly A-120A. See Fig.3-1.

2) Disconnect plugs P614 and P801, referring to Fig.3-2.

3) Unfasten two M8x16 hex. bolts BT-107, and take out the RF transceiver assembly. See Fig.3-2.

NOTE: 1. When placing the RF transceiver assembly on steel desk, great care should be taken to avoid deterioration of the magnetron mounted on the assembly.

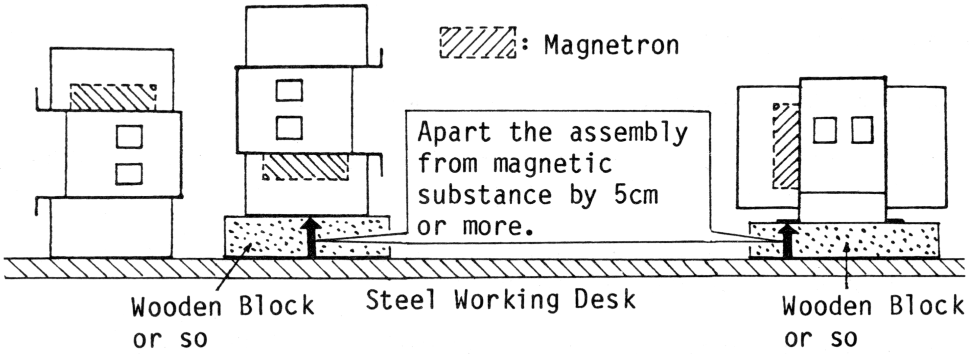

▨: Magnetron
Apart the assembly from magnetic substance by 5cm or more.
Wooden Block or so
Steel Working Desk
Wooden Block or so

Fig.3-5

2. When putting the assembly back, take care that two guide pins are mated with the guide holes.

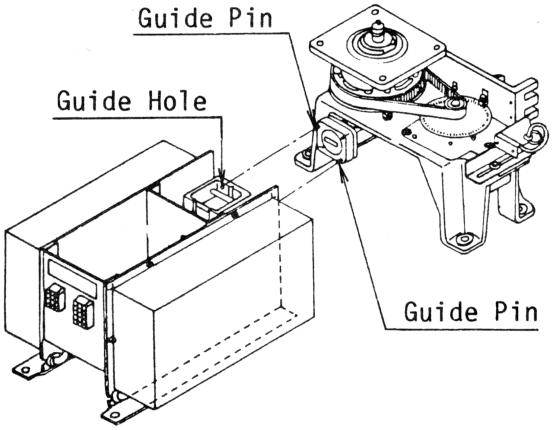

Guide Pin
Guide Hole
Guide Pin

Fig.3-6

3-5. MD-4171, IF-4435 & MC-4363 Boards

MD-4171 MODULATOR and IF-4435 IF AMPLIFIER boards are mounted on the RF transceiver assembly A-190A, while MC-4363 MOTOR CONTROL board is mounted on the scanner driving assembly A-160A. These boards are covered with the shield cases A-191, A-192 and A-111, respectively. See Fig.3-7.

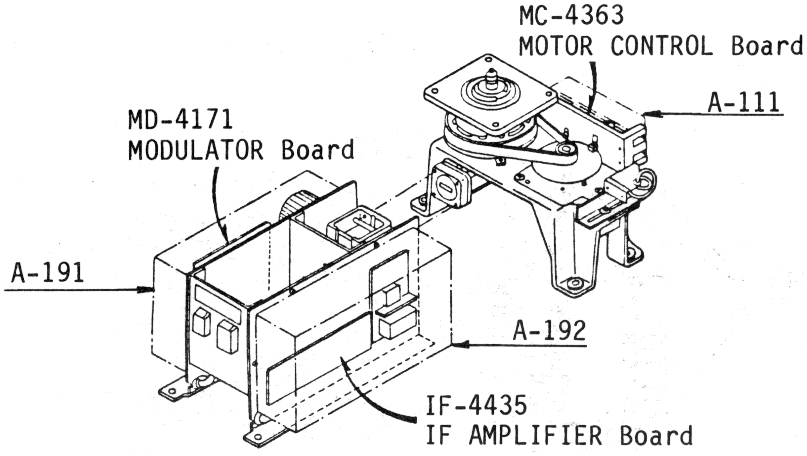


Fig.3-7

1) Unfasten four fixing bolts A-147, and remove radome upper assembly A-120A. See Fig.3-1.

2) Take out the RF transceiver assembly A-190A. See Fig.3-2.

3) Remove respective shield cases A-191, A-192 and A-111, and these boards are in sight.

4) Disconnect plugs and loosen screws fixing each board.

3-6. Magnetron V801

NOTE:
1. Use a non-magnetic screwdriver when replacing the magnetron.
2. Apart the magnetron from magnetic substance by 5cm or more. See Fig.3-5.
3. The magnetron must not be stored in the proximity of ferro-magnetic materials and stray magnetic field to prevent demagnetization.
4. As the magnetron has strong magnetic force, the watch should be taken off while replacing the magnetron to prevent the watch from getting damage.

1) Take out the RF transceiver assembly A-190A. See Fig.3-2.

2) Remove the shield case cover A-191. See Fig.3-7.

3) Unsolder the magnetron heater lead wires from the pulse transformer T801. See Fig.3-8 on next page.

4) Loosen four M4x10 washer head screws S-124 with a non-magnetic screwdriver, and carefully take out the magnetron.

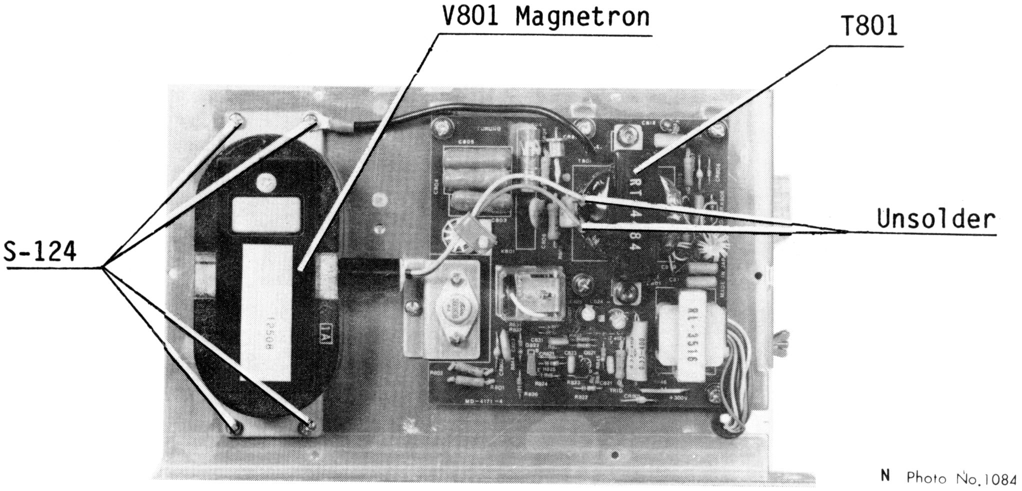

V801 Magnetron
T801
S-124
Unsolder
N Photo No.1084

Fig.3-8

3-7. Circulator HY801 & MIC U801 w/Limiter CR810

1) Take out the RF transceiver assembly A-190A, referring to Fig.3-2. See Note 1 on page 3-3.

2) Remove the shield case A-192. See Fig.3-7.

3) Disconnect the plug P612 connected to the IF-4435 board, and loosen four M4x12 washer head screws S-119.

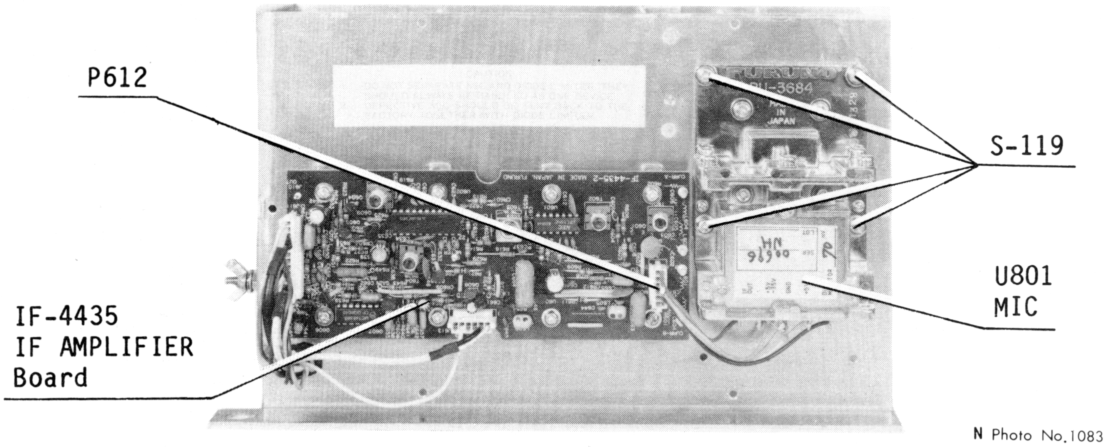

P612
S-119
U801
MIC
IF-4435
IF AMPLIFIER
Board
N Photo No.1083

Fig.3-9

4) Carefully take out the assembly of MIC (w/limiter), circulator and adaptor *1*. Then, loosen four M4x60 pan head screw S-111, and the MIC (w/limiter) and the circulator come free. See Fig.3-10.

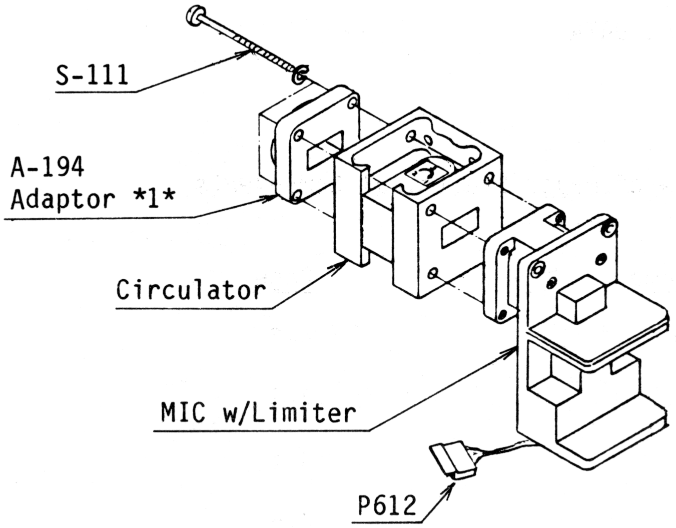
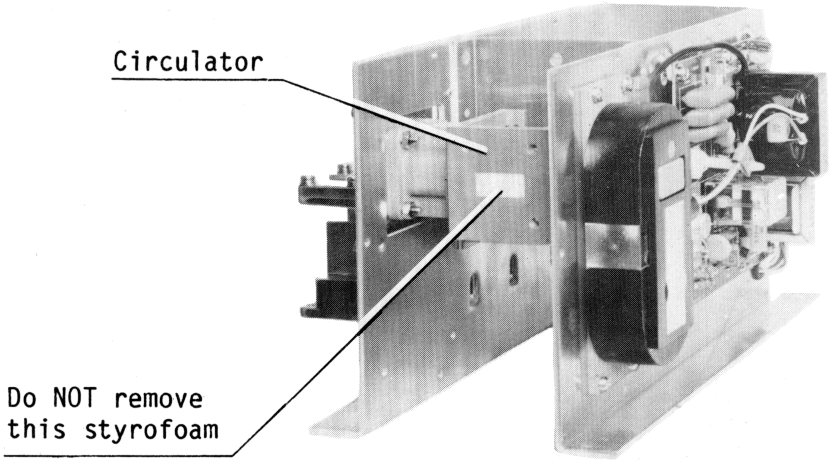

S-111
A-194
Adaptor *1*
Circulator
MIC w/Limiter
P612

Fig.3-10

NOTE:

1. Do NOT separate the MIC and limiter. They should always be handled as one device.
2. The defective MIC should be sent back to the factory together with the limiter.
3. After installing a new MIC, never fail to remove the bare wire which shortcircuits across the lead pins on the MIC. Do NOT energize the radar before removing the shorting wire.
4. On replacement of the circulator, do NOT remove a piece of styrofoam inserted into a port of the circulator. As the magnet is used inside the circulator, metal filings are likely to be attached to it, and if these filings or dust come in, it causes poor sensitivity or deterioration of magnetron.


Circulator
Do NOT remove
this styrofoam

N Photo No.1085

Fig.3-11

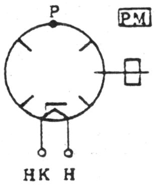
CHAPTER 4. TECHNICAL DATA

4-1. Characteristics of Major Electrical Components

Parts Name	Page
Magnetron	4-2
Circulator	4-3
Limiter	4-4
Diodes	4-5
Zener Diodes	4-5
Transistors	4-6
SCR	4-7
Thermistor	4-7
Digital Integrated Circuit	4-8
Voltage Regulator	4-8
Linear Integrated Circuits	4-9 and 4-10

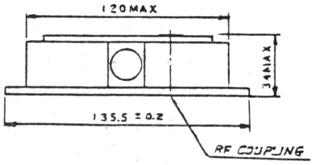
SPECIFICATIONS OF MAGNETRON

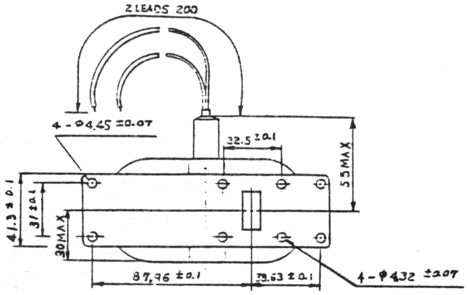
Type	9M302/E3513
Furuno Code No.	000-101-730
Applications	9410MHz band radar pulse transmission
Substitute	9M302, M599F, JP9-2.5



Maximum Ratings

	Min.	Max.	Unit
Heater Voltage (Ef)	5.7	6.9	V
Cathode pre-heating time (tk)	120		sec.
Peak anode voltage (eb)	3.2	3.8	KV
Rate of rise of voltage pulse (rrv)		60	KV/us
Peak anode current (ib)	2.5	3.5	A
Average anode current (Ib)		3.5	mAdc
Peak input power (pi)		13	KW
Average input power (Pi)		13	W
Duty cycle (Du)		0.001	
Pulselength (tp)	0.05	1.0	us
VSWR (σ_L)		1.5	
Plate temperature at test point		120	°C





Electrical Characteristics

	Test Condition	Min.	Typ.	Max.	Unit
Heater current	Ef = 6.3V	0.43	0.52	0.6	A
Peak plate voltage	tp = 0.9 - 1.1us	3.3	3.5	3.7	KV
Average output power	Du = 0.001 Ib = 3.0mAdc	3.0			W
Frequency		9380	9410	9440	MHz
Spectrum Bandwidth	ib = 2.5 - 3.5A		1.2/tp	2.5/tp	MHz
Missing pulses (stability)				0.25	%
Frequency pulling	σ_L = 1.3 min.			18	MHz/°C
Temperature coefficient	Tp = 40 - 70 °C			-0.25	MHz
Life		500			hrs

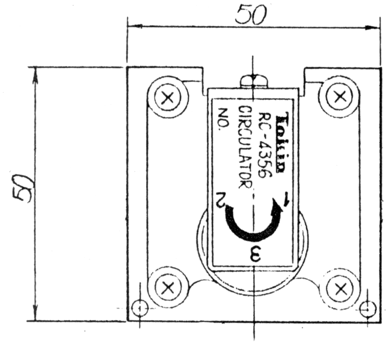
NOTES:
1. Pre-heating time required is 120 seconds minimum for the ambient temperature in excess of 0°C and 180 seconds minimum for 0 to -55°C.
2. Frequency pulling denotes the frequency variation produced in the period of 5 minutes. The measurement is done within 15 minutes after the start of test.
3. The device is defined as its life is over when the average output power drops to 2.4W and the ratio of missing pulses increases to 1% under the test condition stated above.

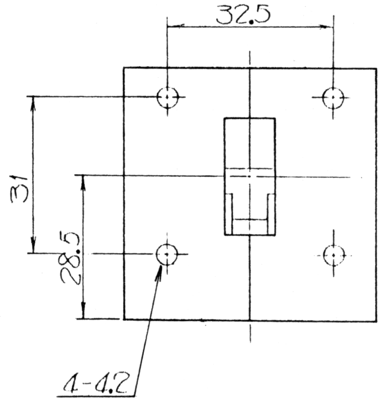
SPECIFICATIONS OF CIRCULATOR

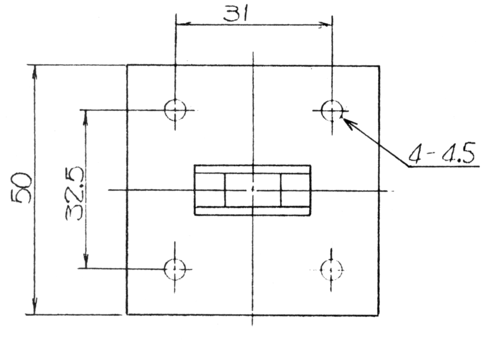
Type:	RC-4356
Furuno Code No.:	000-106-860
Manufacturer:	Tohoku Kinzoku
Application:	X-band, directional coupling

Electrical Characteristics

Frequency Range:	9300 - 9500MHz
Center Frequency:	9400MHz
Bandwidth:	200MHz
Forward Loss (Ta = 25°C):	0.3dB or less
Reverse Loss (Ta = 25°C):	25dB or more
Allowable Average Power:	25W
Allowable Peak Power:	25kW
V.S.W.R.:	1.2 or less


50
50
Tokin
RC-4356
CIRCULATOR
NO.
1
2
3


32.5
31
28.5
4-4.2


31
50
32.5
4-4.5

SPECIFICATIONS OF LIMITER

Type:	S-LX5B(S)
Furuno Code No.:	000-107-088
Application:	X-band Limiter

Maximum Ratings at Tc = 25°C

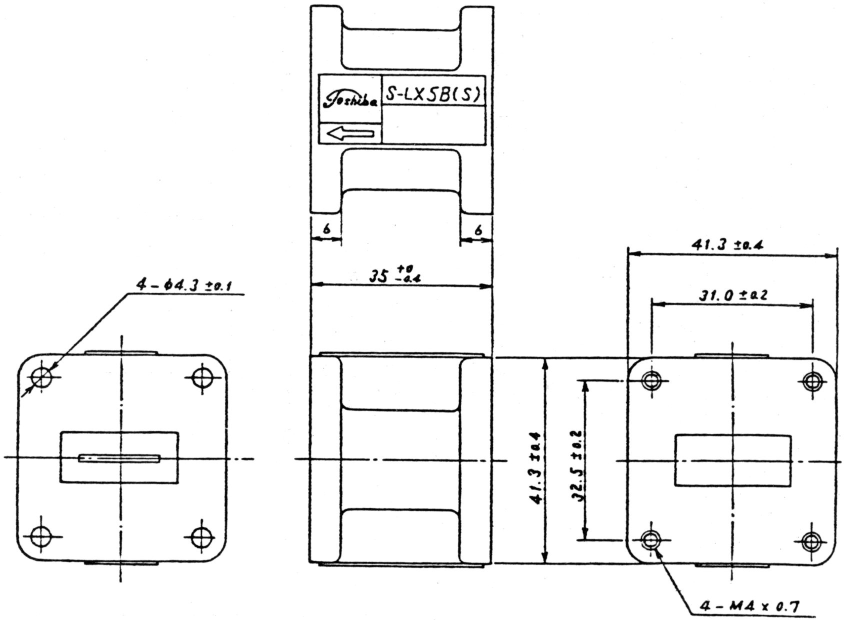
Peak power (see note 1.)	1KW
Average power	2W
Operating temperature	-20 to +70°C
Storage temperature	-30 to +90°C

Electrical Characteristics at Tc=25°C

	Min.	Max.	Unit
Frequency range((see note 2.)	9.3	9.5	GHz
Insertion loss at 9 4GHz (see note 2.)		1.2	dB
VSWR (see note 2.)		1.5	
Flat leakage power (see note 3.)		150	mW
Spike leakage power (see note 3.)		600	mW
Recovery period to -3dB (see note 3.)		0.5	us
Rated power for continuous operation (see notes 1 and 4.)		2	kW

Life-over point: When the insertion loss for 0.5mW continuous wave exceeds 3dB.

NOTE:
1. Measured at frequency 9375MHz, pulselength 1us and pulse repetition rate 1000pps.
2. Measured at continuous wave of less than 0.5mW.
3. Measured at peak power 2kW, frequency 9375MHz, pulselength 1us and pulse repetition rate 1000pps.
4. This value is subject to change with pulse length and case temperature.



*** DIODE ***

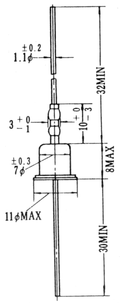
					ABSOLUTE MAX RATINGS AT 25°C						FORWARD (25°C)				REVERSE(25°C)			
TYPE	CODE NO.	MFR.	APPLI-CATION	CONST-RUCTION	VRM (V)	VR (V)	VI (V)	IFM (MA)	IO (MA)	IS (A)	MIN IF (MA)	VF (V)	MAX VF (V)	IF (A)	MAX IR (UA)	VR (V)	OUT-LINE	NOTE/SUBSTITUTE
SB-2	000135012	SKN	R	SI.D	500		350		1.5A*	100			1.1	1.5	10	500	D-1	*TA=60°C/1S1897
V-19E	000136020	HTC	R	SI.D	400				1A	60			1.2	1	10	400	D-2	CATHODE:BLUE
V11J	000136012	HTC	R	SI.D	800				400	25			3	0.4			D-2	
1S1588	000112795	TOS	SW	SI.EP	35	30		360	120	0.5			1.3	0.1	0.5	30	D-3	
1S2095A	000113046	TOS	SW	SI.EP	75	70		750	250	1			0.65	1MA	0.1	50	D-3	

NOTE: VRM=MAXIMUM REVERSE VOLTAGE, VR=MAX DC REVERSE VOLTAGE, VI=MAX AC INPUT VOLTAGE(RMS), IFM=MAX PEAK FORWARD CURRENT, IO=MAX AVERAGE DC OUTPUT CURRENT, IS=MAX FORWARD TRANSIT CURRENT, IF=FORWARD CURRENT, VF=FORWARD VOLTAGE, IR=REVERSE CURRENT, VR=REVERSE VOLTAGE.

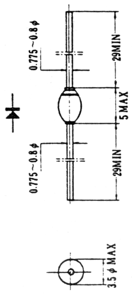
*** ZENER DIODE ***

					ABS MAX		ZENER VOLTAGE VZ				MAX DYNAMIC RESISTANCE		THERMAL COEFFICIENT OF VZ	REVERSE (25°C)			
TYPE	CODE NO.	MFR.	APPLI-CATION	CONST-RUCTION	P (MW)	IZ (MA)	MIN (V)	AVG (V)	MAX (V)	IZ (MA)	RZ (OHM)	IZ (MA)	(% /°C)	MAX IR (UA)	VR (V)	OUT-LINE	NOTE/SUBSTITUTE
RD10EB	000134816	NEC		SI.PL	400		9.4		10.6	20	10	20		2	7	D-3	
RD22EB	000134840	NEC		SI.EP	400		20.8		24.5	5	60	5		2	17	D-3	
RD6.8FB	000134800	NEC		SI.PL	1		6.4		7.2	40	6	40		20	3.5	D-4	
05Z5.1X	000110804	TOS		SI.PL	500	86	4.8	5.1	5.4	5	50	5	0.030	1	1	D-3	

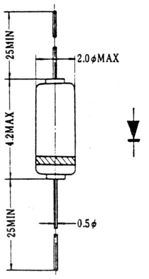
NOTE: P=MAXIMUM POWER DISSIPATION, IZ=ZENER CURRENT, IR=REVERSE CURRENT, VR=REVERSE VOLTAGE.


±0.2
1.1ϕ
32MIN
3 +0 −1
10 +0 −3
±0.3
7ϕ
8MAX
11ϕMAX
30MIN

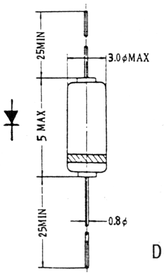
D-1


0.775~0.8ϕ
29MIN
5 MAX
0.775~0.8ϕ
29MIN
3.5ϕMAX

D-2


25MIN
2.0ϕMAX
4.2MAX
25MIN
0.5ϕ

D-3


25MIN
3.0ϕMAX
5 MAX
25MIN
0.8ϕ

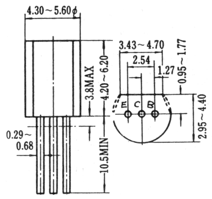
D-4

*** TRANSISTOR ***

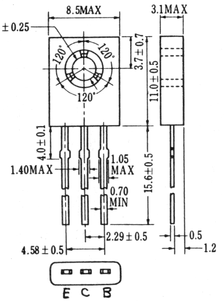
TYPE	CODE NO.	MFR.	APPLI-CATION	CONST-RUCTION	ABSOLUTE MAX RATINGS AT 25°C					CHARACTERISTICS(25°C)					TO NO.	OUT-LINE	NOTE/SUBSTITUTE
					VCBO (V)	VEBO (V)	IC (MA)	PC (MW)	TJ (°C)	VCE (V)	IC (MA)	HFE	FT (MHZ)				
2SA495GTMY	000116993	TOS	RF	SI.E	-50	-5	-150	400	125	-1	-10	120-240	100			TR-1	
2SA715WTC	000117430	HTC	RF	SI.EP	-35	-5	-2.5A	10W*	150	-2	-500	100-200	160			TR-2	* AT TC=25°C
2SB595-0	000121103	TOS	PA	SI.T	-100	-5	-5A	40W*	150	-5	1A		5			TR-3	*AT TC=25°C
2SC367GTM0	000123552	TOS	RF.CONV	SI.EP	40	5	400	400	125	1	100	70-140	120			TR-1	COMPLEMENT.2SA467GTM-0
2SC372GTMY	000123561	TOS	RF.CONV	SI.E	60	5	150	400	125	12	2	120-240	200			TR-1	
2SC752GTM0	000124129	TOS	RF	SI.EP	40	5	200	400	125	1	100	70-140	400			TR-1	
2SC945	000124420	NEC	RF.AF	SI.E	60	5	100	250	125	6	1	200	250			TR-1	CONPLEMENT 2SA733

NOTE: VCBO=COLLECTOR-BASE VOLTAGE (EMITTER OPEN), VEBO=EMITTER-BASE VOLTAGE (COLLECTOR OPEN), IC=COLLECTOR CURRENT, PC=POWER DISSIPATION, TJ=JUNCTION TEMPERATURE, VCE=COLLECTOR-EMITTER VOLTAGE, IC=COLLECTOR CURRENT, HFE=STATIC FORWARD CURRENT TRANSFER RATIO, FT=TRANSITION FREQUENCY.

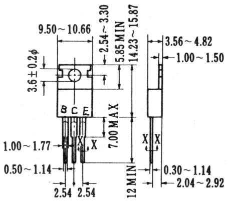
MANUFACTURER(MFR.): FUJ=FUJITSU, HTC=HITACHI, IRJ=INTERNATIONAL RECTIFIER (JAPAN), MAT=MATSUSHITA, MOT=MOTOROLA, MTB=MITSUBISHI, NEC=NIPPON ELECTRIC, NJR=NEW JAPAN RADIO, OKI=OKI ELECTRIC, ORG=ORIGIN ELECTRIC, SKN=SANKEN ELECTRIC, SND=SHINDENGEN ELECTRIC, SON=SONY,-STL=STANLEY ELECTRIC, SYO=SANYO, TOS=TOSHIBA, FJD=FUJI ELECTRIC


4.30~5.60ϕ
3.43~4.70
2.54
1.27
0.95~1.77
3.8MAX
4.20~6.20
E C B
2.95~4.40
0.29~0.68
10.5MIN

TR-1


8.5MAX
3.1MAX
3ϕ±0.25
120°
120°
120°
3.7±0.7
11.0±0.5
4.0±0.1
1.40MAX
1.05 MAX
0.70 MIN
15.6±0.5
2.29±0.5
0.5
1.2
4.58±0.5
E C B

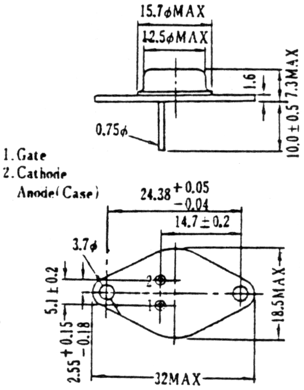
TR-2


9.50~10.66
2.54~3.30
5.85MIN
14.23~15.87
3.56~4.82
1.00~1.50
3.6±0.2ϕ
B C E
7.00MAX
X
X
X X
1.00~1.77
0.50~1.14
12MIN
0.30~1.14
2.04~2.92
2.54 2.54

TR-3

SPECIFICATIONS OF SCR

Type:	S6080B
Furuno Code No.:	000-135-000

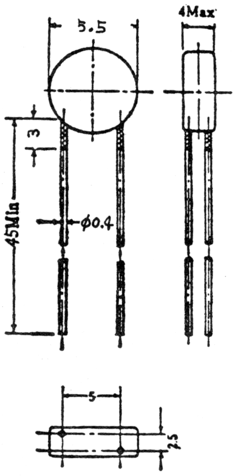

15.7φMAX
12.5φMAX
1.6
7.3MAX
10.0±0.5
0.75φ
1. Gate
2. Cathode
Anode(Case)
24.38 +0.05 −0.04
14.7±0.2
3.7φ
5.1±0.2
2.55 +0.15 −0.18
2
1
18.5MAX
32MAX

Electrical Characteristics

Absolute Maximum Ratings	
Repetitive Peak Off-state Volt.:	750V
Non-repetitive Peak Off-state Volt.:	800V
Repetitive Peak Reverse Volt.:	5V
On-state Current Total rms Value:	5A
On-state Current w/Alternating Comp.:	3.2A (dc value)
Surge On-state Current:	70A (60Hz)
Critical Rate of Rise of On-state Current:	200A/us
Peak Gate Power Dissipation:	25W
Average Gate Power Dissipation:	0.5W
Peak Gate Voltage:	-35V
Junction Temperature:	-40 to +100°C
Storage Temperature:	-40 to +150°C

SPECIFICATIONS OF THERMISTOR

Type:	D-22A
Furuno Code No.:	000-180-617


5.5
4Max
3
45Min
φ0.4
5
2.5

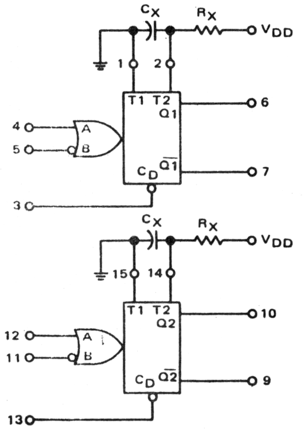
Electrical Characteristics

Maximum Ratings	
Withstanding Current:	80mA
Operating Current:	5mA
Operating Voltage:	1V
Operating Temperature:	-20 to +70°C
Resistance at Ta = 25°C:	170 to 225ohms
Material Constant:	2950 to 3550°K
Heat Dissipation Constant:	5.5mW/°C
Temperature Coefficient:	-3.3 to -4.0%/°C

SPECIFICATIONS OF DIGITAL IC (C-MOS)

Type:	MC14538BCP
Furuno Code No.:	000-170-016
Manufacturer:	Motorola
Function:	Dual Monostable Multivibrator

Logic Diagram


CX
RX
VDD
1
2
T1 T2
Q1
6
4
5
A
B
CD
Q̄1
7
3
CX
RX
VDD
15
14
T1 T2
Q2
10
12
11
A
B
CD
Q̄2
9
13

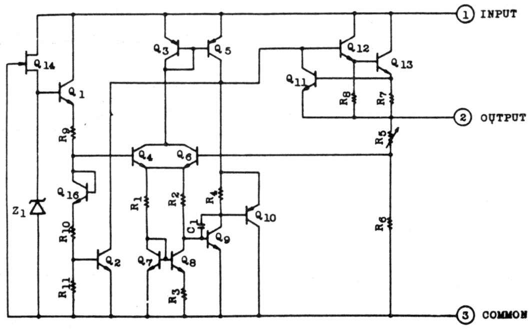
R_X and C_X are external components.

V_{DD} = Pin 16
V_{SS} = Pin 8, Pin 1, Pin 15

SPECIFICATIONS OF VOLTAGE REGULATOR

Type:	TA78L005AP
Furuno Code No.:	000-163-606
Manufacturer:	Toshiba
Function:	+5V Regulator

Equivalent Circuit

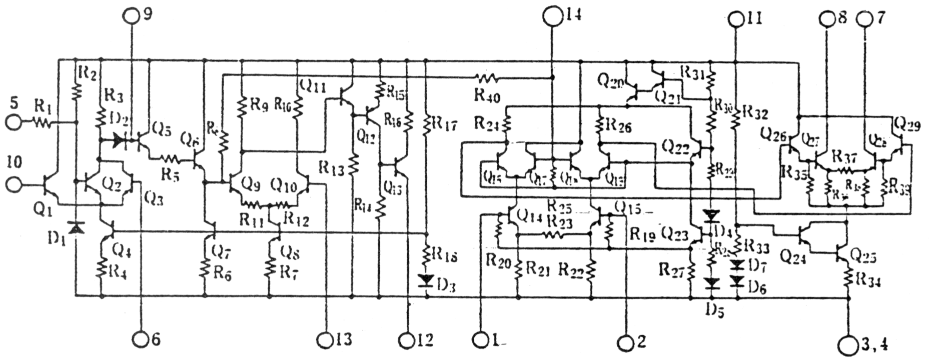

① INPUT
② OUTPUT
③ COMMON
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q10
Q11
Q12
Q13
Q14
Q16
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
C1
Z1

SPECIFICATIONS OF LINEAR IC (TV Video IF Amp.)

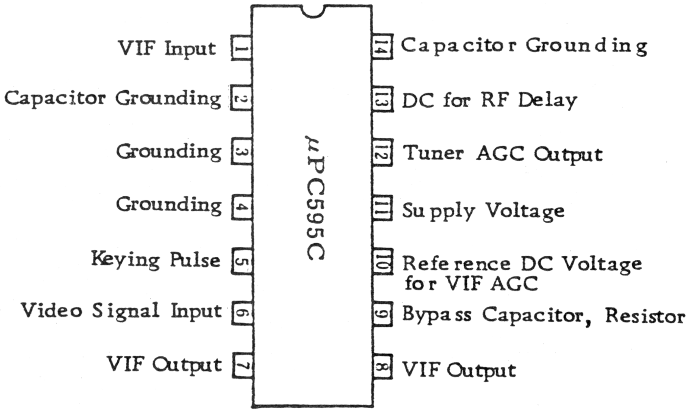
Type: µPC595C
Furuno Code No.: 000-161-060

Absolute Maximum Ratings at Ta=25°C

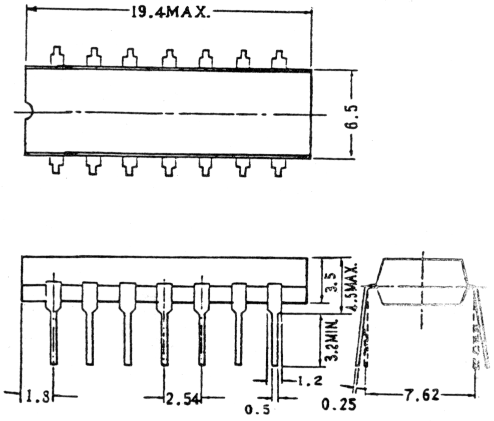
Supply voltage to pin 11	18V
Supply voltage to pins 7 and 8	18V
Input voltage between pins 1 and 2	10V
Supply voltage to pins 6 and 10	6V
Input voltage to pin 5	+10, -20V
Power consumption	400mW at Ta=70°C
Operating temperature	-20 to +70°C
Storage temperature	-40 to +125°C


9
14
11
8
7
5
10
6
13
12
1
2
3,4
Q1
D1
R1
R2
R3
D2
Q2
Q3
Q4
R4
Q5
Q6
R5
Q7
R6
Q8
R7
Q9
Q10
R9
R10
R11
R12
Q11
Q12
R13
R14
R15
R16
R17
Q13
R18
D3
R40
R24
R26
Q20
Q21
R31
R30
R32
Q22
Q26
Q27
Q28
Q29
R37
R35
R38
R39
Q14
R25
R23
Q15
R19
Q23
R20
R21
R22
R27
D4
R33
D7
D6
D5
Q24
Q25
R34

EQUIVALENT CIRCUIT


µPC595C
1 VIF Input
2 Capacitor Grounding
3 Grounding
4 Grounding
5 Keying Pulse
6 Video Signal Input
7 VIF Output
14 Capacitor Grounding
13 DC for RF Delay
12 Tuner AGC Output
11 Supply Voltage
10 Reference DC Voltage for VIF AGC
9 Bypass Capacitor, Resistor
8 VIF Output

CONNECTION DIAGRAM (TOP VIEW)


19.4MAX.
6.5
3.5
4.5MAX.
3.2MIN.
1.2
1.8
2.54
0.5
0.25
7.62

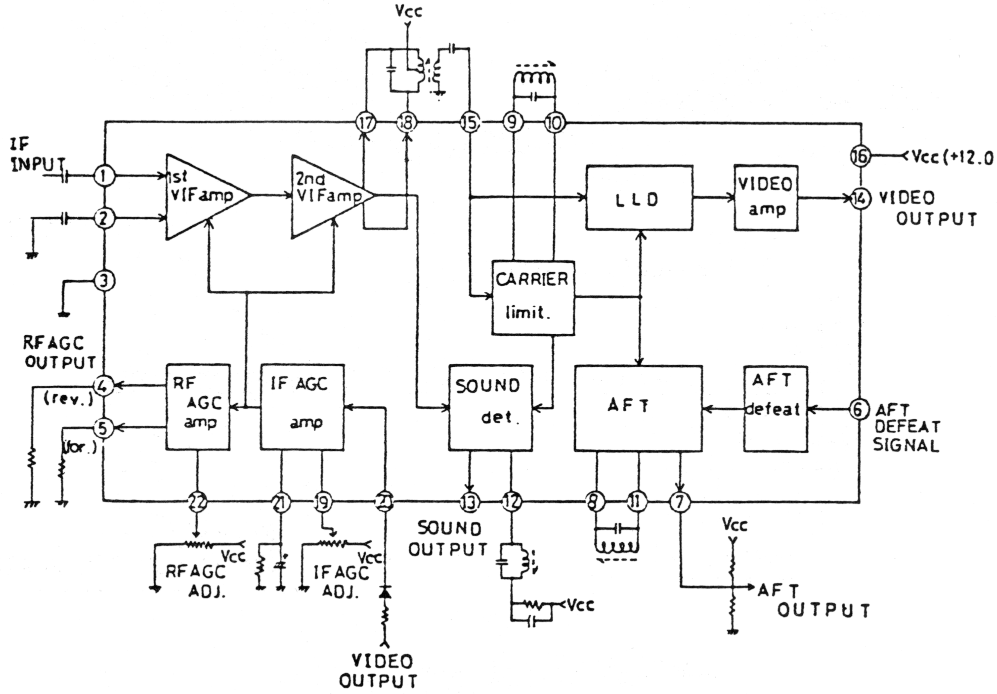
OUTLINE

SPECIFICATIONS OF LINEAR IC (TV IF Sig. Processing)

Type: M5186P
Furuno Code No.: 000-150-284
Application: TV IF Amp, Video Detector, Auto Freq. Control

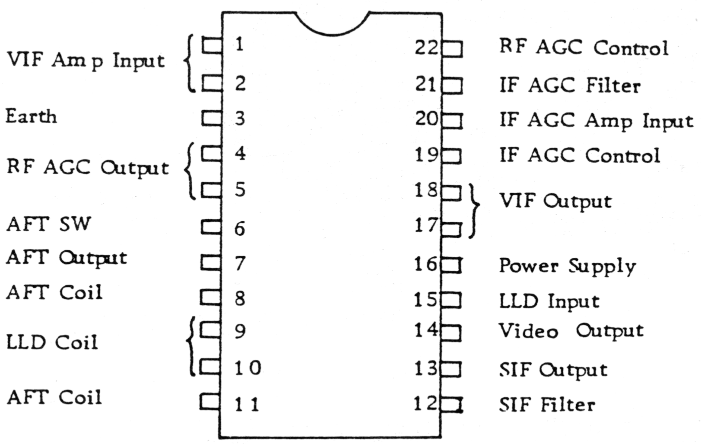
Absolute Maximum Ratings (Ta = 25°C)

Supply Voltage:	16V
Power Dissipation:	1.4W
Operating Temperature:	-20 to +75°C
Storage Temperature:	-40 to +125°C

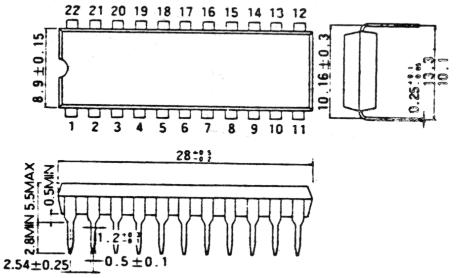


Vcc
IF INPUT
1st VIF amp
2nd VIF amp
LLD
VIDEO amp
Vcc (+12.0V)
VIDEO OUTPUT
CARRIER limit.
RF AGC OUTPUT
(rev.)
(for.)
RF AGC amp
IF AGC amp
SOUND det.
AFT
AFT defeat
AFT DEFEAT SIGNAL
SOUND OUTPUT
Vcc
RF AGC ADJ.
IF AGC ADJ.
VIDEO OUTPUT
AFT OUTPUT

BLOCK DIAGRAM



VIF Amp Input
1
2
Earth
3
RF AGC Output
4
5
AFT SW
6
AFT Output
7
AFT Coil
8
LLD Coil
9
10
AFT Coil
11
22
RF AGC Control
21
IF AGC Filter
20
IF AGC Amp Input
19
IF AGC Control
18
17
VIF Output
16
Power Supply
15
LLD Input
14
Video Output
13
SIF Output
12
SIF Filter



22 21 20 19 18 17 16 15 14 13 12
1 2 3 4 5 6 7 8 9 10 11
8.9±0.15
10.16±0.3
28
2.8MIN
5.5MAX
0.5MIN
1.2
2.54±0.25
0.5±0.1

CONNECTION DIAGRAM (TOP VIEW)

CHAPTER 5. PARTS LOCATION

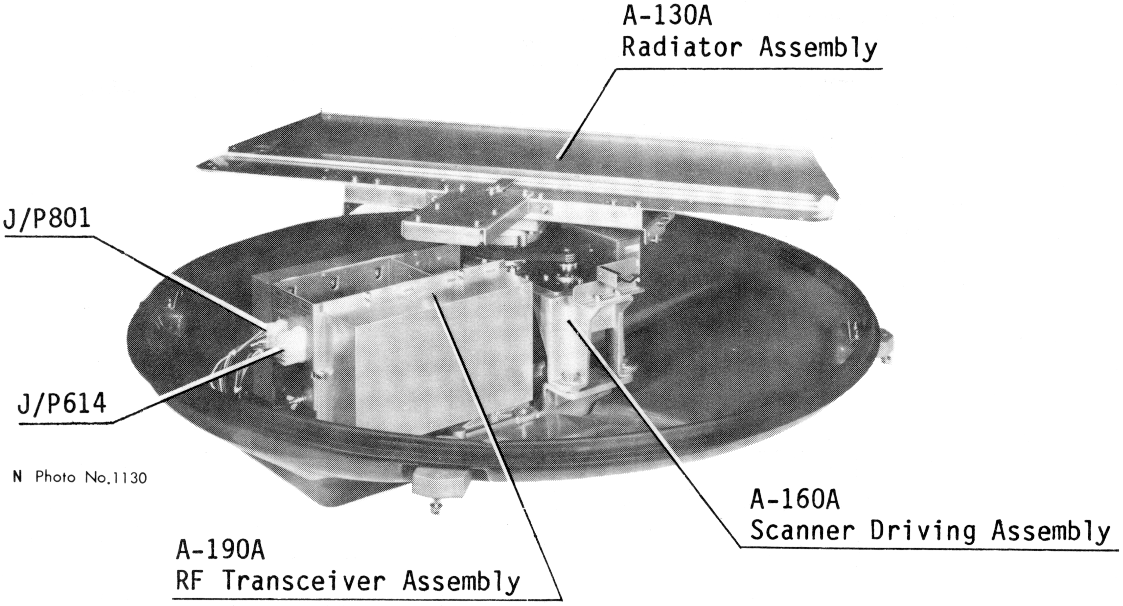

A-130A
Radiator Assembly
J/P801
J/P614
N Photo No.1130
A-160A
Scanner Driving Assembly
A-190A
RF Transceiver Assembly

Fig.5-1 Scanner Unit with RF Transceiver Assy.

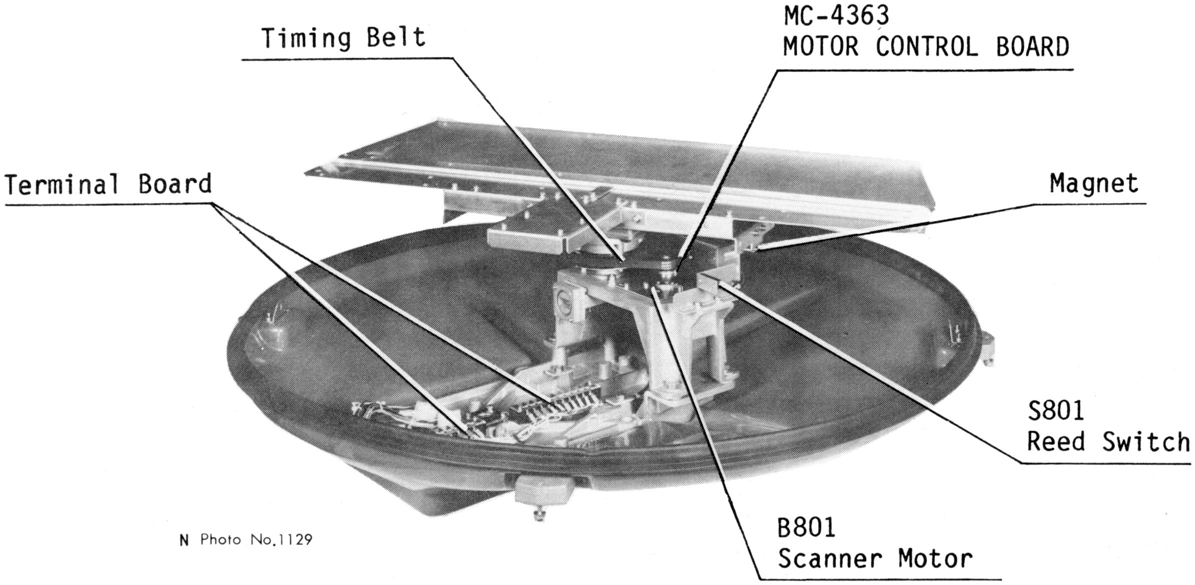
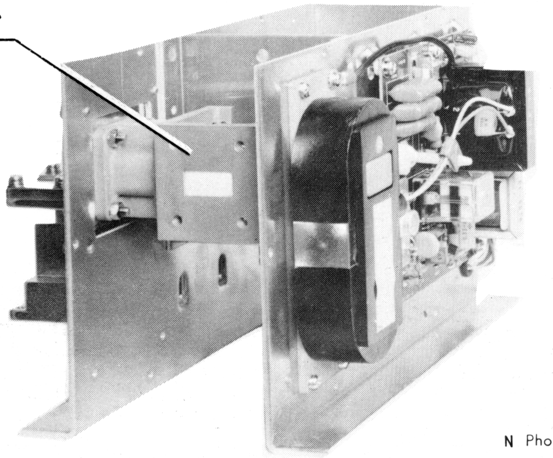

Timing Belt
MC-4363
MOTOR CONTROL BOARD
Terminal Board
Magnet
S801
Reed Switch
N Photo No.1129
B801
Scanner Motor

Fig.5-2 Scanner Unit without RF Transceiver Assy.



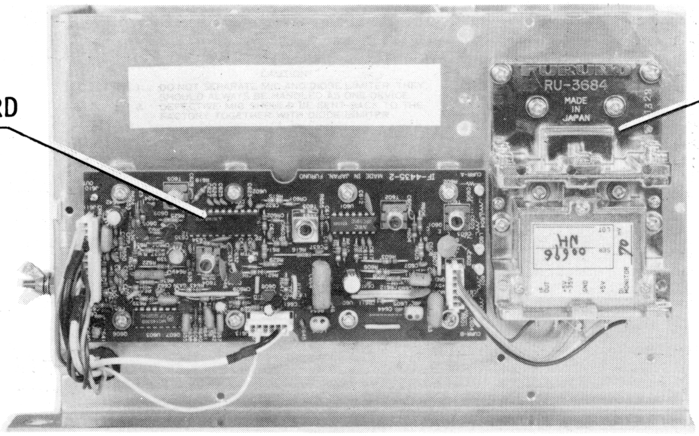
HY801
Circulator

See Fig.5-4.

See Fig.5-5.

N Photo No.1085

Fig.5-3 RF Transceiver Assembly


RU-3684
MADE IN JAPAN

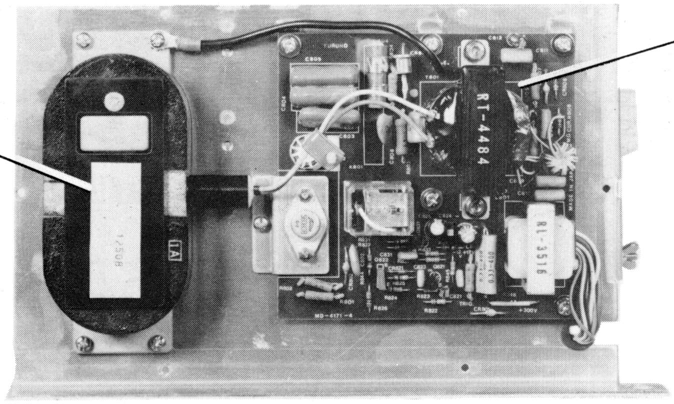
IF-4435
IF AMPLIFIER BOARD

U801/CR810
MIC/Limiter

Note: Do NOT separate.

N Photo No.1083

Fig.5-4 Side View of RF Transceiver Assy.


RT-4484
RT-3516

MD-4171
MODULATOR BOARD

V801
Magnetron

N Photo No.1084

Fig.5-5 Side View of RF Transceiver Assy.

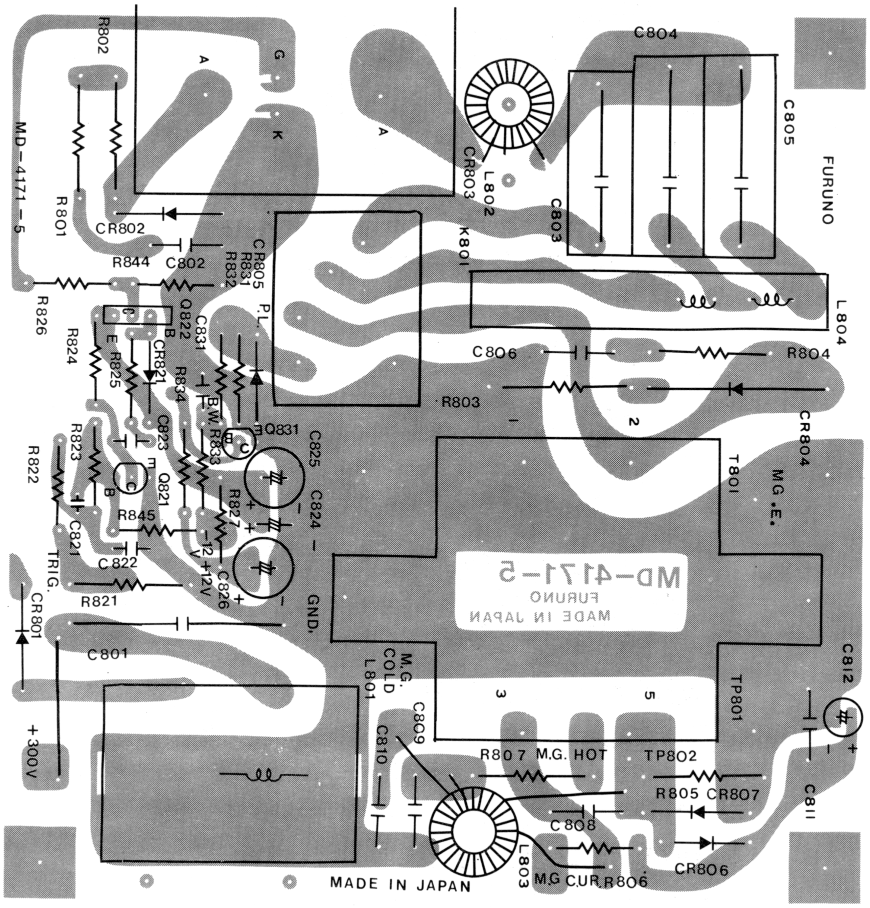

C804
C805
FURUNO
L802
CR803
C803
K801
L804
A
G
K
A
R802
MD-4171-5
R801
CR802
R844
C802
CR805
R831
R832
P.L.
R826
Q822
C831
R824
R825
CR821
R834
B.W.
R833
Q831
C825
C806
R804
R803
CR804
T801
M.G.E.
R823
C823
R822
Q821
R845
R827
C824
C821
C822
TRIG.
-12
+12V
C826
GND.
CR801
R821
MD-4171-5
FURUNO
MADE IN JAPAN
C801
+300V
M.G.
COLD
L801
C809
C810
3
5
TP801
C812
R807
M.G. HOT
TP802
R805
CR807
C811
C808
L803
M.G CUR.
R806
CR806
MADE IN JAPAN

Fig.5-6 MODULATOR BOARD (MD-4171)

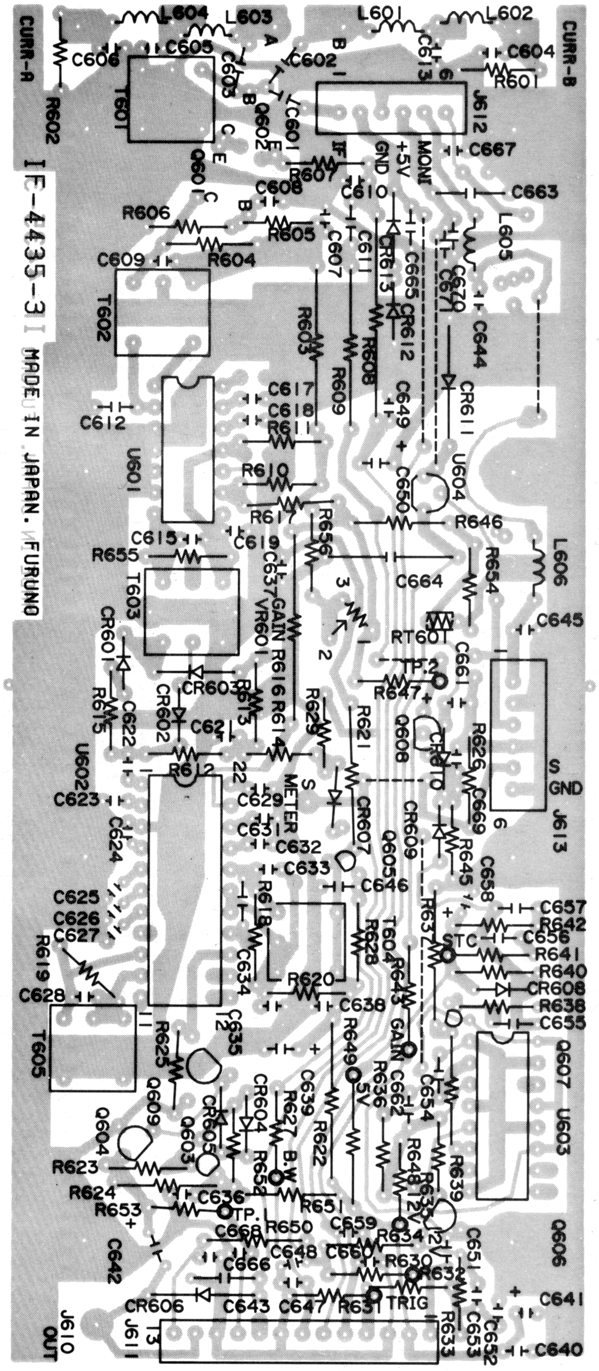

CURR-A
CURR-B
L601
L602
L603
L604
C604
C605
C606
R601
R602
C602
C603
C613
J612
T601
Q601
Q602
C601
B
C
E
A
IF
GND
+5V
MONI
C667
C663
R607
C608
C610
R606
R605
R604
C609
C607
C611
CR613
C665
L605
C670
C671
C644
T602
R603
R608
CR612
R609
C649
CR611
C612
C617
C618
R611
U601
R610
C650
U604
R617
R656
R646
C615
C619
R655
C637
C664
R654
L606
T603
VR601
GAIN
RT601
C645
CR601
R616
TP.2
C661
R647
R615
CR603
R613
R629
R621
Q608
R626
CR602
C621
R614
CR610
C669
C622
R612
S
GND
U602
METER
CR607
CR609
R645
J613
C623
C629
C631
C632
C633
Q605
C658
C624
C646
C657
C625
C626
C627
R618
R628
T604
R637
STC
R642
C656
R641
R640
R619
C634
R620
R643
CR608
C628
C638
R638
C655
T605
R625
C635
R649
GAIN
C662
C654
Q607
CR604
C639
R636
5V
R639
U603
Q609
CR605
R627
R622
R648
Q604
Q603
R652
B.W
R635
R623
R624
C636
R651
12V
R653
TP.
C668
R650
C659
R634
C651
Q606
C642
C666
C648
C660
R630
R632
C641
CR606
C643
C647
R631
TRIG
R633
C653
C652
J610
OUT
J611
13
C640
IF-4435-3I MADE IN JAPAN. FURUNO

Fig.5-7 IF AMPLIFIER BOARD (IF-4435)

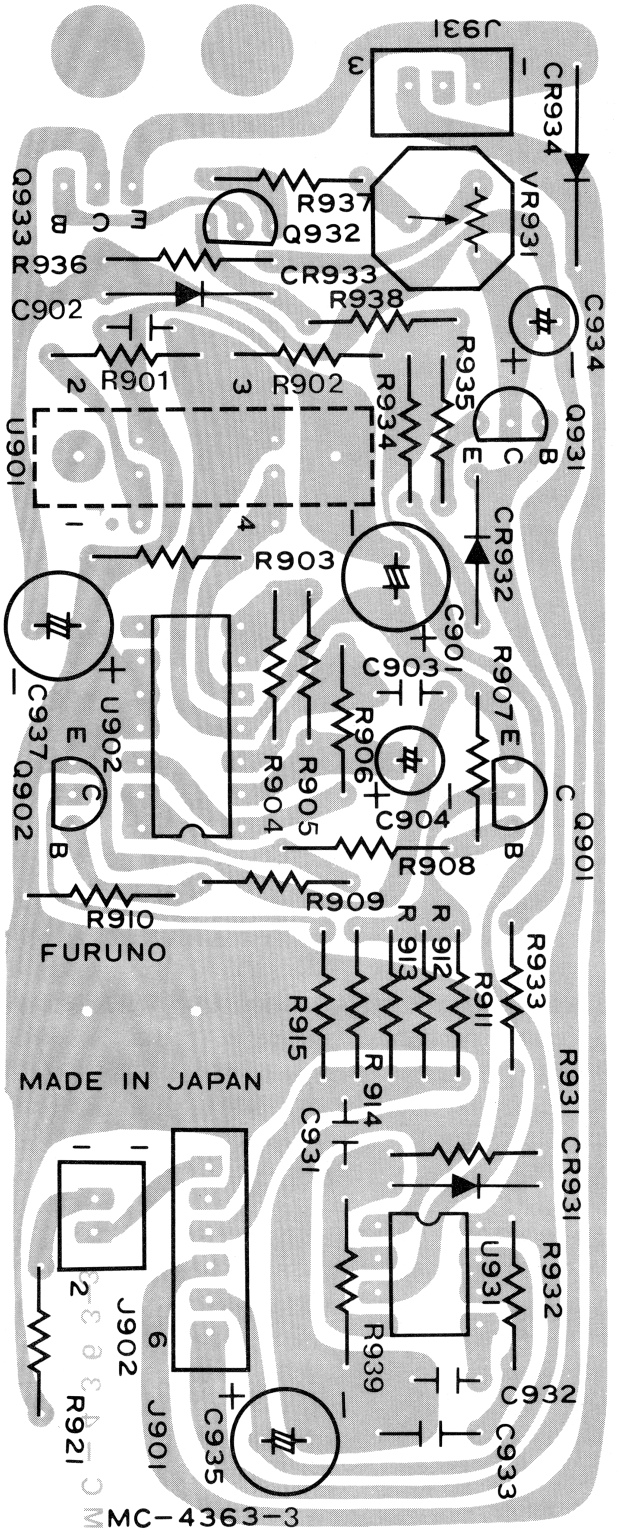

J931
CR934
VR931
R937
Q932
Q933
E C B
R936
CR933
C902
R938
C934
R901
R902
R935
R934
Q931
U901
E C B
CR932
R903
C901
C937
U902
C903
R907
Q902
E C B
R904
R905
R906
C904
Q901
C B
R908
R909
R910
FURUNO
R913
R912
R911
R933
R915
R914
R931
MADE IN JAPAN
C931
CR931
U931
R932
J902
R939
C932
R921
J901
C935
C933
MC-4363-3

Fig.5-8 MOTOR CONTROL BOARD (MC-4363)

FURUNO

MODEL 2400

SCANNER UNIT
空 中 線 部

REF. DWG. No.
参照図番 C3255-008-A

SYMBOL 記号		TYPE 型名	SPECIFICATIONS 規格	CODE NO. コード番号	REMARKS 備考
		PRINTED CIRCUIT BOARD ﾌﾟﾘﾝﾄｷﾊﾞﾝ			
		IF-4435		003-037-540	IF AMP W/CASE
		MD-4171		003-037-550	MODULATOR
		MC-4363		003-037-570	MOTOR CONTROL
		MOTOR	ﾓｰﾀｰ		
B	801	OSR-F	13-3-4510	000-432-000	
		CAPACITOR	ｺﾝﾃﾞﾝｻｰ		
C	601	DD109E103P50V02	0.01UF 50V	000-253-436	
C	607	DD104B102K50V02	1000PF 50V	000-252-171	
C	608	DD104B102K50V02	1000PF 50V	000-252-171	
C	609	ECC-F1H100DC	10PF,50V	000-255-210	
C	610	DD104B102K50V02	1000PF 50V	000-252-171	
C	611	ECQ-M 1H 682KZ	6800PF 50V	000-260-371	
C	612	DD109E103P50V02	0.01UF 50V	000-253-436	
C	615	ECC-D1H220JC	22PF 50VDC	000-255-218	
C	617	DD104B102K50V02	1000PF 50V	000-252-171	
C	618	DD104B102K50V02	1000PF 50V	000-252-171	
C	619	DD104B102K50V02	1000PF 50V	000-252-171	
C	621	DD104B102K50V02	1000PF 50V	000-252-171	
C	622	DD104B102K50V02	1000PF 50V	000-252-171	
C	623	DD104B102K50V02	1000PF 50V	000-252-171	
C	624	DD104B102K50V02	1000PF 50V	000-252-171	
C	625	DD104B102K50V02	1000PF 50V	000-252-171	
C	626	DD104B102K50V02	1000PF 50V	000-252-171	
C	627	DD104B102K50V02	1000PF 50V	000-252-171	
C	628	ECC-F1H150JC2	15PF 50V	000-256-902	
C	629	DD104B102K50V02	1000PF 50V	000-252-171	
C	631	DD104B102K50V02	1000PF 50V	000-252-171	
C	632	DD104B102K50V02	1000PF 50V	000-252-171	
C	633	ECC-F1H150JC2	15PF, 50V	000-256-902	
C	634	DD109E103P50V02	0.01UF 50V	000-253-436	
C	635	DD104B102K50V02	1000PF 50V	000-252-171	
C	636	DD104B102K50V02	1000PF 50V	000-252-171	
C	637	DD104B102K50V02	1000PF 50V	000-252-171	
C	638	DD104B102K50V02	1000PF 50V	000-252-171	
C	639	ECE-A1CS101	100UF 16V	000-201-427	
C	640	DD104B102K50V02	1000PF 50V	000-252-171	
C	641	ECE-A1CS100	10UF 16V	000-201-423	
C	642	ECE-A1CS101	100UF 16V	000-201-427	
C	643	ECQ-M1H473KZ	47000PF 50V	000-260-385	
C	644	DD104B102K50V02	1000PF 50V	000-252-171	
C	645	DD104B102K50V02	1000PF 50V	000-252-171	
C	646	DD109E103P50V02	0.01UF 50V	000-253-436	
C	647	DD104B102K50V02	1000PF 50V	000-252-171	
C	648	DD104B102K50V02	1000PF 50V	000-252-171	
C	649	DD104B102K50V02	1000PF 50V	000-252-171	
C	650	ECE-A1CS101	100UF 16V	000-201-427	
C	651	DD104B102K50V02	1000PF 50V	000-252-171	
C	652	DD104B102K50V02	1000PF 50V	000-252-171	
C	653	RPE110CH331J50	330PF, 50V	000-251-702	
C	654	ECQ-M1H103KZ	0.01UF 50V	000-260-370	
C	655	ECQ-M1H103KZ	0.01UF 50V	000-260-370	
C	656	ECQ-M 1H 222KZ	2200PF 50V	000-260-366	
C	657	ECQ-M-1H122KZ	1200PF 50WV	000-260-361	
C	658	ECE-A1CS100	10UF 16V	000-201-423	
C	659	DD104B102K50V02	1000PF 50V	000-252-171	
C	660	DD104B102K50V02	1000PF 50V	000-252-171	
C	661	ECE-A1CS100	10UF 16V	000-201-423	
C	662	DD104B102K50V02	1000PF 50V	000-252-171	
C	663	ECQ-M1H104KZ	0.1UF 50V	000-260-390	
C	664	ECQ-M 1H 334KZ	0.33UF 50V	000-260-389	
C	665	DD109E103P50V02	0.01UF 50V	000-253-436	
C	666	DD104B102K50V02	1000PF 50V	000-252-171	
C	667	DD104B102K50V02	1000PF 50V	000-252-171	
C	668	DD104B102K50V02	1000PF 50V	000-252-171	
C	669	RPE110CH101J50	100PF, 50V	000-251-700	
C	670	DD104B102K50V02	1000PF 50V	000-252-171	
C	671	DD104B102K50V02	1000PF 50V	000-252-171	
C	801	MD-1-2G-334M	0.33UF, 400V	000-202-089	
C	802	ECK-D3A222KB2	2200PF	000-255-750	
C	803	ECW-H06H123JD	0.012UF	000-259-529	
C	804	ECW-H06H223JD	0.022 UF	000-259-532	
C	805	ECW-H06H223JD	0.022 UF	000-259-532	
C	806	ECK-D3A392KBN	3900pF	000-255-754	
C	807	ECQ-M1H104KZ	0.1UF 50V	000-260-390	
C	808	ECQ-M1H104KZ	0.1UF 50V	000-260-390	
C	809	ECQ-M1H104KZ	0.1UF 50V	000-260-390	
C	810	ECQ-M1H104KZ	0.1UF 50V	000-260-390	
C	811	ECQ-M1H104KZ	0.1UF 50V	000-260-390	
C	812	ECE-A1HS010	1UF 50V	000-201-459	
C	821	RPE110CH331J50	330PF, 50V	000-251-702	
C	822	ECQ-M1H102KZ	1000PF 50V	000-260-360	
C	823	ECQ-M1H102KZ	1000PF 50V	000-260-360	
C	824	CS99E1D6R8M3	6.8UF	000-232-060	
C	825	ECE-A1CS101	100UF 16V	000-201-427	
C	826	ECE-A1CS101	100UF 16V	000-201-427	
C	831	ECQ-M1H103KZ	0.01UF 50V	000-260-370	
C	840	DD104B102K50V02	1000PF 50V	000-252-171	
C	901	ECE-A1CS101	100UF 16V	000-201-427	
C	902	DD109E103P50V02	0.01UF 50V	000-253-436	
C	903	ECQ-M1H103KZ	0.01UF 50V	000-260-370	
C	904	ECE-A1CS100	10UF 16V	000-201-423	
C	931	ECQ-M1H103KZ	0.01UF 50V	000-260-370	
C	932	ECQ-M1H103KZ	0.01UF 50V	000-260-370	
C	933	ECQ-M1H473KZ	47000PF 50V	000-260-385	
C	934	ECE-A1ES100	10UF 25V	000-201-436	
C	935	ECE-A1CS101	100UF 16V	000-201-427	
C	937	ECE-A1CS101	100UF 16V	000-201-427	
		DIODE	ﾀﾞｲｵｰﾄﾞ		
CR	601	1S1588		000-112-795	
CR	602	1S1588		000-112-795	
CR	603	1S1588		000-112-795	
CR	604	1S1588		000-112-795	
CR	605	1S1588		000-112-795	
CR	606	1S1588		000-112-795	
CR	607	05Z5.1X	VF-50N M2	000-110-804	
CR	608	1S1588		000-112-795	
CR	609	1S1588		000-112-795	
CR	610	1S1588		000-112-795	
CR	611	RD-6.8FB		000-134-800	
CR	612	RD22EB		000-134-840	
CR	613	RD22EB		000-134-840	
CR	801	V11J		000-136-012	
CR	802	V11J		000-136-012	
CR	803	S6080B		000-135-000	
CR	804	SB2		000-135-012	
CR	805	1S2095A		000-113-046	
CR	806	1S1588		000-112-795	
CR	807	V11J		000-136-012	
CR	810	S-LX5B(S)		000-107-088	
CR	821	1S1588		000-112-795	
CR	931	1S1588		000-112-795	
CR	932	1S1588		000-112-795	
CR	933	RD10EB		000-134-816	
CR	934	V19E		000-136-020	
		CIRCULATOR	ｻｰｷｭﾚｰﾀ		
HY	801	RC-4356		000-106-860	
		JACK	ｼﾞﾔﾂｸ		
J	611	B13P-SHF-1AA	13P	000-505-563	
J	612	B6P-SHF-1AA	6P	000-505-554	
J	613	B6P-SHF-1AA	6P	000-505-554	
J	614	LR-15		000-505-475	
		LLM-01T-2.0		000-505-494	CONTACT 13PCS
J	801	LR-12		000-505-473	
		LLM-01T-2.0		000-505-494	CONTACT 11PCS
J	901	B6P-SHF-1AA	6P	000-505-554	
J	902	B2P-SHF-1AA	2P	000-505-550	
J	931	B3P-SHF-1AA	3P	000-505-551	
		RELAY	ﾘﾚｰ		
K	801	HC1-P-DC12V		000-454-521	
		COIL	ｺｲﾙ		
L	605	EL0710-5R6K00S0037	5.6UH 270MA	000-427-625	
L	606	EL0710-5R6K00S0037	5.6UH 270MA	000-427-625	
L	801	RL-3516	13-3-3516	000-733-516	
L	802	RL4584		000-734-584	
		OR-12.4-6HSB-5		000-421-402	CORE
L	803	RL-3903		000-733-903	
		OR-12.4-6HSB-5		000-421-402	CORE
L	804	RL-4170	12-3-4170	000-734-170	
		PLUG	ﾌﾟﾗｸﾞ		
P	611	H13P-SHF-AA,13P	NH HOUSING	000-505-610	
		LHF-001T-08S		000-505-301	CONTACT 13PCS
P	612	H6P-SHF-AA,6P	NH HOUSING	000-505-599	
		LHF-001T-08S		000-505-301	CONTACT 6PCS
P	613	H6P-SHF-AA,6P	NH HOUSING	000-505-599	
		LHF-001T-08S		000-505-301	CONTACT 6PCS

NOTE:
備 考:

SYMBOL 記号	TYPE 型名	SPECIFICATIONS 規格	CODE NO. コード番号	REMARKS 備考
P 614	LP-15		000-505-461	
	LLF-01T-2.0		000-505-495	CONTACT 13PCS
P 801	LP-12		000-505-460	
	LLF-01T-2.0		000-505-495	CONTACT 11PCS
P 901	H6P-SHF-AA,6P	NH HOUSING	000-505-599	
	LHF-001T-08S		000-505-301	CONTACT 6PCS
P 902	H2P-SHF-AA,2P	NH HOUSING	000-505-595	
	LHF-001T-08S		000-505-301	CONTACT 2PCS
P 931	H3P-SHF-AA,3P	NH HOUSING	000-505-596	
	LHF-001T-08S		000-505-301	CONTACT 2PCS
	TRANSISTOR	トランジスター		
Q 601	2SC606(B)T		000-123-915	
Q 602	2SC606(B)T		000-123-915	
Q 603	2SC372GTM-Y		000-123-561	
Q 604	2SA495GTM-Y		000-116-993	
Q 605	2SC372GTM-Y		000-123-561	
Q 606	2SC372GTM-Y		000-123-561	
Q 607	2SC372GTM-Y		000-123-561	
Q 608	2SC372GTM-Y		000-123-561	
Q 609	2SA495GTM-Y		000-116-993	
Q 821	2SC752GTM-O		000-124-129	
Q 822	2SA715C		000-117-430	
Q 831	2SC945		000-124-420	
Q 901	2SA495GTM-O		000-116-992	
Q 902	2SC367GTM-O		000-123-552	
Q 931	2SA495GTM-O		000-116-992	
Q 932	2SC945		000-124-420	
Q 933	2SB595-O		000-121-103	
	RESISTOR	テイコウ		
R 603	ERD-25TJ101	0.25W 100	000-330-333	
R 604	ERD-25TJ561	0.25W 560	000-330-351	
R 605	ERD-25TJ392	0.25W 3.9K	000-330-371	
R 606	ERD-25TJ472	0.25W 4.7K	000-330-373	
R 608	ERD-25TJ272	0.25W 2.7K	000-330-367	
R 609	ERD-25TJ331	0.25W 330	000-330-345	
R 610	ERD-25TJ102	0.25W 1K	000-330-357	
R 611	ERD-25TJ151	0.25W 150	000-330-337	
R 612	ERD-25TJ102	0.25W 1K	000-330-357	
R 613	ERD-25TJ821	0.25W 820	000-330-355	
R 614	ERD-25TJ332	0.25W 3.3K	000-330-369	
R 615	ERD-25TJ391	0.25W 390	000-330-347	
R 616	ERD-25TJ152	0.25W 1.5K	000-330-361	
R 617	ERD-25TJ331	0.25W 330	000-330-345	
R 618	ERD-25TJ221	0.25W 220	000-330-341	
R 619	ERD-25TJ471	0.25W 470	000-330-349	
R 620	ERD-25TJ100	0.25W 10	000-330-309	
R 621	ERD-25TJ100	0.25W 10	000-330-309	
R 622	ERD-25TJ100	0.25W 10	000-330-309	
R 623	ERD-25TJ220	0.25W 22	000-330-317	
R 624	ERD-25TJ222	0.25W 2.2K	000-330-365	
R 625	ERD-25TJ222	0.25W 2.2K	000-330-365	
R 626	ERD-25TJ105	0.25W 1M	000-330-429	
R 627	ERD-25TJ102	0.25W 1K	000-330-357	
R 628	ERD-25TJ223	0.25W 22K	000-330-389	
R 629	ERD-25TJ222	0.25W 2.2K	000-330-365	
R 630	ERD-25TJ101	0.25W 100	000-330-333	
R 631	ERD-25TJ102	0.25W 1K	000-330-357	
R 632	ERD-25TJ102	0.25W 1K	000-330-357	
R 633	ERD-25TJ682	0.25W 6.8K	000-330-377	
R 634	ERD-25TJ473	0.25W 47K	000-330-397	
R 635	ERD-25TJ103	0.25W 10K	000-330-381	
R 636	ERD-25TJ223	0.25W 22K	000-330-389	
R 637	ERD-25TJ103	0.25W 10K	000-330-381	
R 638	ERD-25TJ102	0.25W 1K	000-330-357	
R 639	ERD-25TJ392	0.25W 3.9K	000-330-371	
R 640	ERD-25TJ223	0.25W 22K	000-330-389	
R 641	ERD-25TJ272	0.25W 2.7K	000-330-367	
R 642	ERD-25TJ271	0.25W 270	000-330-343	
R 643	ERD-25TJ100	0.25W 10	000-330-309	
R 645	ERD-25TJ104	0.25W 100K	000-330-405	
R 646	ERD-25TJ271	0.25W 270	000-330-343	
R 647	ERD-25TJ331	0.25W 330	000-330-345	
R 648	ERD-25TJ100	0.25W 10	000-330-309	
R 649	ERG-1ANJ390	1W 39	000-371-227	
R 650	ERD-25TJ103	0.25W 10K	000-330-381	
R 651	ERD-25TJ100	0.25W 10	000-330-309	
R 652	ERD-25TJ102	0.25W 1K	000-330-357	
R 653	ERD-25TJ104	0.25W 100K	000-330-405	
R 654	ERD-25TJ221	0.25W 220	000-330-341	
R 655	ERD-25TJ103	0.25W 10K	000-330-381	
R 656	ERD-25TJ102	0.25W 1K	000-330-357	
R 657	ERD-25TJ682	0.25W 6.8K	000-330-377	
R 801	ERG-1ANJ220	1W 22	000-371-225	
R 802	ERG-1ANJ220	1W 22	000-371-225	
R 803	ERX-2ANJ3R9	2W 3.9	000-371-163	
R 804	ERX-1ANJ5R1	1W 5.1	000-371-072	
R 805	ERX-1ANJ1R0	1W 1	000-371-055	
R 806	ERD-25TJ102	0.25W 1K	000-330-357	
R 807	ERX-1ANJR62	1W 0.62	000-371-050	
R 821	ERG-1ANJ101	1W 100	000-371-240	
R 822	ERD-25TJ102	0.25W 1K	000-330-357	
R 823	ERD-25TJ682	0.25W 6.8K	000-330-377	
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R 827	ERD-25TJ100	0.25W 10	000-330-309	
R 831	ERD-25TJ103	0.25W 10K	000-330-381	
R 832	ERD-25TJ103	0.25W 10K	000-330-381	
R 833	ERD-25TJ473	0.25W 47K	000-330-397	
R 834	ERD-25TJ223	0.25W 22K	000-330-389	
R 844	ERD-25TJ470	0.25W 47	000-330-325	
R 845	ERD-25TJ473	0.25W 47K	000-330-397	
R 901	ERD-25TJ561	0.25W 560	000-330-351	
R 902	ERD-25TJ100	0.25W 10	000-330-309	
R 903	ERD-25TJ222	0.25W 2.2K	000-330-365	
R 904	ERD-25TJ222	0.25W 2.2K	000-330-365	
R 905	ERD-25TJ332	0.25W 3.3K	000-330-369	
R 906	ERD-25TJ333	0.25W 33K	000-330-393	
R 907	ERD-25TJ102	0.25W 1K	000-330-357	
R 908	ERD-25TJ472	0.25W 4.7K	000-330-373	
R 909	ERD-25TJ103	0.25W 10K	000-330-381	
R 910	ERD-25TJ102	0.25W 1K	000-330-357	
R 911	ERD-25TJ391	0.25W 390	000-330-347	
R 912	ERD-25TJ391	0.25W 390	000-330-347	
R 913	ERD-25TJ391	0.25W 390	000-330-347	
R 914	ERD-25TJ391	0.25W 390	000-330-347	
R 915	ERD-25TJ101	0.25W 100	000-330-333	
R 921	ERD-25TJ331	0.25W 330	000-330-345	
R 931	ERD-25TJ103	0.25W 10K	000-330-381	
R 932	ERD-25TJ563	0.25W 56K	000-330-399	
R 933	ERD-25TJ152	0.25W 1.5K	000-330-361	
R 934	ERD-25TJ102	0.25W 1K	000-330-357	
R 935	ERD-25TJ561	0.25W 560	000-330-351	
R 936	ERD-25TJ152	0.25W 1.5K	000-330-361	
R 937	ERD-25TJ102	0.25W 1K	000-330-357	
R 938	ERD-25TJ122	0.25W 1.2K	000-330-359	
R 939	ERD-25TJ223	0.25W 22K	000-330-389	
	THERMISTOR	サーミスター		
RT 601	D-22A		000-180-617	
	SWITCH	スイッチ		
S 801	NRS-109		000-478-020	
	TRANSFORMER	トランス		
T 601	RT-4487-1	12-3-4487-2	000-734-487	
T 602	RT-4488	12-3-4488	000-734-488	
T 603	RT-4489	12-3-4489	000-734-489	
T 604	RT-4490	12-3-4490	000-734-490	
T 605	RT-4490	12-3-4490	000-734-490	
T 801	RT-4484		000-734-484	
	TERMINAL BOARD	タンシバン		
RTB	LK-10P W/NO.1-10		000-533-510	
	LK-10P W/NO.11-20		000-533-511	
	INTEGRATED CIRCUIT	シユウセキカイロ		
U 601	UPC595C		000-161-060	
U 602	M5186P		000-150-284	
U 603	MC14538BCP	CMOS	000-170-016	
U 604	TA78L005AP		000-163-606	
U 801	RU-3684	13-3-3684	000-633-684	MIC *1
U 901	ON-1102		000-134-100	
U 902	HA17902P		000-162-082	
U 931	TA7555P		000-163-007	
	ELECTRON TUBE	デンシカン		
V 801	9M302/E3513	9410MHZ 3KW	000-101-730	
	POTENTIOMETER	ポテンショメーター		
VR 601	RGP102-503	50K	000-316-261	
VR 931	RGP102-202	2K	000-316-256	MOTOR SPEED ADJ.

NOTE: *1: U801 IS SUPPLIED WITH CR810 AS MIC ASSY.
備 考: (CODE NO. 008-316-440)

SYMBOL 記 号		PARTS NAME 部 品 名	TYPE／DWG. NO. 型 名／図 番	CODE NO. コード番号	REMARKS 備 考
A	101	BALANCER HOUSING	03-001-4014-1	300-140-141	
A	102	BALANCER	03-001-4008-2	300-140-082	
A	103	DRAIN TUBE	03-003-3001-0	300-330-010	
A	110A	SCANNER UNIT ASSEMBLY	C1P9N2N9D1-U	003-037-580	FOR USA
A	110A	SCANNER UNIT ASSEMBLY	C1P9N2N9D1-S	003-037-590	FOR OTHER THAN USA.
A	111	SHIELD CASE	03-003-3236-2	300-332-362	
A	120A	RADOME UPPER ASSEMBLY	C1P9N2N M-1600	003-037-600	
A	121	RADOME	C1P9N2N	003-037-660	
A	122	RADOME FIXTURE ＊1＊	03-003-3102-1	300-331-021	
A	123	FURUNO LABEL	03-003-3103-0	300-331-030	
A	130A	RADIATOR ASSEMBLY	XN9	003-037-610	
A	131				NOT SUPPLIED
A	132	MAGNET	RP-1757 MS4X9X15	000-499-055	
A	133	MAGNET MOUNTING PLATE	03-001-4021-2	300-140-212	
A	134	STOPPER	03-001-4013-4	300-140-134	
A	140A	RADOME LOWER ASSEMBLY	C1P9N2N M-1600	003-037-490	
A	141	FLAT WASHER	JIS F8801 A25A BRASS	000-870-205	
A	142	FLAT WASHER	JIS F8801 A25A BRASS	000-870-205	
A	143	RUBBER PACKING	JIS F8801 25A RUBBER	000-870-223	
A	144	CLAMPING PLATE	03-002-3222-0	300-232-220	
A	145	SCANNER LOWER HOUSING	C1P9N2N	003-037-640	
A	146	RADOME FIXTURE ＊2＊	03-003-3202-1	300-332-021	
A	147	FIXING BOLT	03-003-3203-1	300-332-031	
A	148	PACKING FOR DOME	03-003-3204-2	300-332-042	
A	149	SEAL	03-003-3211-0	300-332-110	
A	150	RF ASSY. FIXTURE	03-003-3207-2	300-332-072	
A	151	NUT SOLDERED PLATE	03-003-3208-1	300-332-081	
A	152	RUBBER BLIND	03-003-3209-0	300-332-090	
A	160A	SCANNER DRIVING ASSEMBLY	C1P9N2N M-1600	003-037-480	
A	161	TIMING BELT	150 X L037G	000-841-127	
A	162	BEARING	6006ZZ PS2	000-873-233	
A	163	BEARING	6006ZZ PS2	000-873-233	
A	164	REED SWITCH FIXING PLATE	03-003-3252-1	300-332-521	
A	165	PEDESTAL	03-003-3301-2	300-333-012	
A	166	ADAPTOR ＊2＊	03-003-3302-0	300-333-020	
A	167	MOTOR FIXING PLATE	03-003-3231-2	300-332-312	
A	168	TIMING DISK W/DRIVE GEAR	03-003-3232-1	300-332-321	
A	169	SPACER	03-003-3237-0	300-332-370	
A	170	SCANNER DRIVING PEDESTAL	03-003-3308-1	300-333-081	
A	171	IDLE PULLEY	03-003-3309-0	300-333-090	
A	172	PULLEY FIXING DISK	03-003-3311-1	300-333-111	
A	173	BEARING COLLAR	03-003-3312-0	300-333-120	
A	174	BEARING COLLAR	03-003-3312-0	300-333-120	
A	175	ADAPTOR WAVEGUIDE	C1P9N2N	003-037-290	
A	190A	RF TRANSCEIVER ASSEMBLY	C1P9N2N M-1600	003-037-510	
A	191	SHIELD CASE COVER ＊1＊	03-004-5304-2	300-453-042	
A	192	SHIELD CASE COVER ＊1＊	03-004-5304-2	300-453-042	
A	193	RF CHASSIS	03-004-5311-1	300-453-111	
A	194	ADAPTOR ＊1＊	03-004-5306-0	300-453-060	
BT	101	HEXAGONAL HEAD BOLT	M4 X 12	000-862-177	8PCS
BT	102	HEXAGONAL HEAD BOLT	M4 X 10	000-862-110	
BT	103	HEXAGONAL HEAD BOLT	M4 X 10	000-862-110	2PCS
BT	104	HEXAGONAL HEAD BOLT	M5 X 25	000-862-125	4PCS
BT	105	HEXAGONAL HEAD BOLT	M6 X 25	000-862-180	8PCS
BT	106	HEXAGONAL HEAD BOLT	M8 X 20	000-862-147	4PCS
BT	107	HEXAGONAL HEAD BOLT	M8 X 16	000-862-350	2PCS
BT	108	HEXAGONAL HEAD BOLT	M4 X 12	000-862-177	4PCS
BT	109	HEXAGONAL HEAD BOLT	M4 X 12	000-862-177	4PCS
BT	110	HEXAGONAL HEAD BOLT	M6 X 12	000-862-127	2PCS
BT	111	HEXAGONAL HEAD BOLT	M4 X 25	000-868-784	4PCS
BT	112	HEXAGONAL HEAD BOLT	M4 X 16	000-862-179	2PCS
BT	113	HEXAGONAL HEAD BOLT	M4 X 22	000-862-142	2PCS
N	101	HEXAGONAL NUT	M6	000-863-109	3PCS
S	101	WASHER HEAD SCREW ＊B＊	M4 X 10	000-881-446	2PCS

NOTE:

備 考:

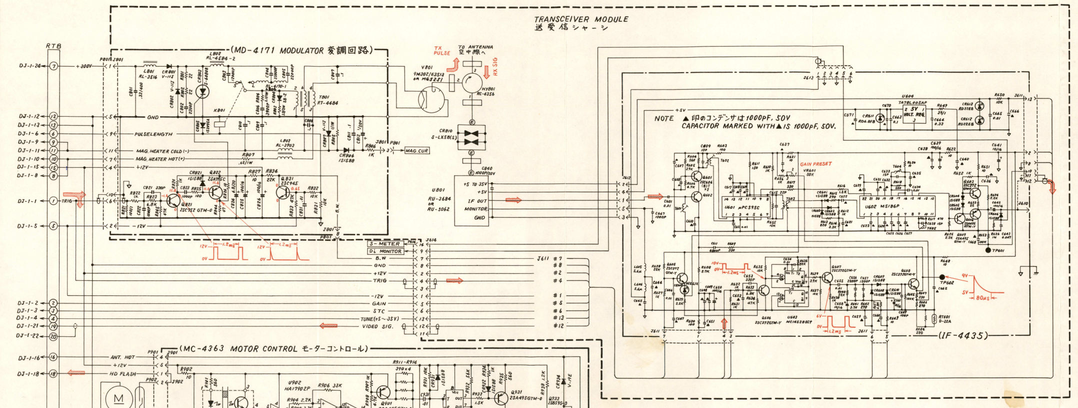
SYMBOL 記 号	PARTS NAME 部 品 名	TYPE／DWG. NO. 型 名／図 番	CODE NO. コード番号	REMARKS 備 考
S 102	WASHER HEAD SCREW *B*	M4 X 10	000-881-446	3PCS
S 103	WASHER HEAD SCREW *A*	M4 X 8	000-881-144	4PCS
S 104	WASHER HEAD SCREW *B*	M4 X 10	000-881-446	2PCS
S 105	WASHER HEAD SCREW *A*	M3 X 10	000-881-105	
S 106	WASHER HEAD SCREW *B*	M4 X 10	000-881-446	3PCS
S 107	WASHER HEAD SCREW *A*	M3 X 6	000-881-103	4PCS
S 108	WASHER HEAD SCREW *A*	M3 X 15	000-881-107	2PCS
S 109	PAN HEAD SCREW	M3 X 15	000-861-117	2PCS
S 110	WASHER HEAD SCREW *A*	M3 X 8	000-881-104	2PCS
S 111	PAN HEAD SCREW	M4 X 60	000-861-025	4PCS
S 112	WASHER HEAD SCREW *A*	M3 X 8	000-881-104	2PCS
S 113	WASHER HEAD SCREW *A*	M4 X 10	000-881-145	3PCS
S 114	WASHER HEAD SCREW *B*	M3 X 12	000-881-406	2PCS
S 115	SOCKET SET SCREW	M4 X 5	000-861-607	
S 116	SOCKET SET SCREW	M4 X 5	000-861-607	
S 117	WASHER HEAD SCREW *B*	M4 X 12	000-881-447	2PCS
S 118	WASHER HEAD SCREW *B*	M4 X 8	000-881-445	5PCS
S 119	WASHER HEAD SCREW *A*	M4 X 12	000-881-146	4PCS
S 120	WASHER HEAD SCREW *B*	M4 X 8	000-881-445	6PCS
S 121	WASHER HEAD SCREW *B*	M4 X 8	000-881-445	6PCS
S 122	PAN HEAD SCREW	M4 X 20	000-861-095	
S 123	WASHER HEAD SCREW *B*	M3 X 6	000-881-403	8PCS
S 124	WASHER HEAD SCREW *A*	M4 X 10	000-881-145	4PCS

NOTE:
備 考:

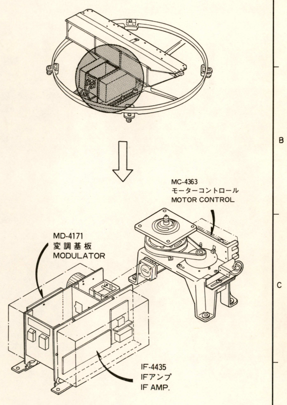
MODEL 2400 SCHEMATIC DIAGRAM

図番
DWG.NO. C3255-008-A

空 中 線 部
SCANNER UNIT

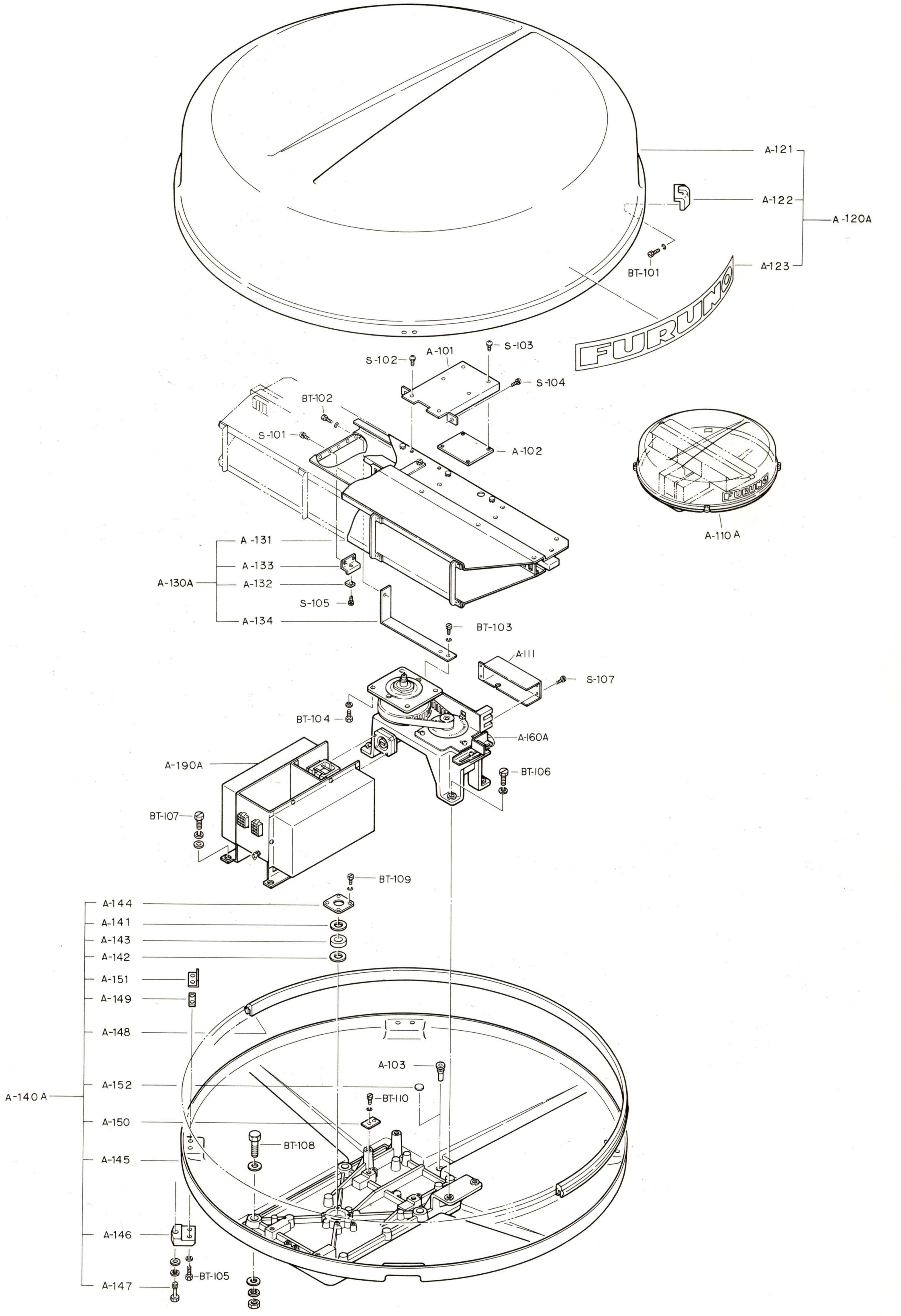

TRANSCEIVER MODULE
送受信シャーシ
RTB
(MD-4171 MODULATOR 変調回路)
TX PULSE
TO ANTENNA
空中線へ
RX SIG
V801 9M302/E3513 OR MG5251
HY801 RC-4356
T801 RT-4484
K801
CR810 S-LXS8(S)
C840 1000P/50V
U801 RU-3684 OR RU-5062
+5 TO 35V
+5V
IF OUT
MONITOR
GND
MAG.CUR
GND
PULSELENGTH
MAG. HEATER COLD(−)
MAG. HEATER HOT(+)
+12V
TRIG
−12V
Q821 2SC752 GTM-0
Q822 2SA715C
Q831 2SC945
B.W.
12V
0V
1.2ms
S-METER
Di MONITOR
B.W
GND
+12V
TRIG
−12V
GAIN
STC
TUNE(+5~35V)
VIDEO SIG.
J614
J611
(MC-4363 MOTOR CONTROL モーターコントロール)
ANT. HOT
+12V
HD FLASH
GND
BEARING
ANT.COLD
MOTOR(−)
MOTOR(+)
B801
S801 NRS-109
U901 ON-1102
U902 HA17902P
Q901 2SA495GTM-0
Q902 2SC367 GTM-0
U931 TA7555P
Q931 2SA495GTM-0
Q932 2SC945
Q933 2SB595-0
MOTOR SPEED ADJ.
BEARING PULSE GEN.
方位信号発生
F-V CONTROL
F-V 制御
U601 μPC595C
U602 M5186P
U603 MC14538BCP
U604 TA78L005AP
5V VOLT. REG.
GAIN PRESET
VR601 50K
Q601 2SC606
Q602
Q603 2SC372
Q605 2SC372 GTM-Y
Q606 2SC372GTM-Y
Q607 2SC372GTM-Y
Q608 2SC372GTM-Y
TP601
TP602
10V
0V
6V
9V
5V
80μs
RT601 D-22A
(IF-4435)

NOTE ▲印のコンデンサは1000pF, 50V
CAPACITOR MARKED WITH ▲ IS 1000pF, 50V.


MC-4363
モーターコントロール
MOTOR CONTROL
MD-4171
変調基板
MODULATOR
IF-4435
IFアンプ
IF AMP.

NOTE 1. 特記無き抵抗の単位は全てΩ, 1/4W ヌコンデンサはμF.
ALL RESISTANCE IN OHMS, 1/4W AND CAPACITANCE IN MICROFARADS UNLESS NOTED OTHERWISE.
2. DC電圧値はGAIN, STC共に最大, ST-BY/ショートレンジで測定。
DC VOLTAGES ARE MEASURED WITH GAIN MAX & STC MAX ON ST-BY/SHORT RANGE.
3. 波形図はGAIN. STC共に最大、送信/ロングレンジで測定。
WAVEFORMS ARE MEASURED WITH GAIN MAX & STC MAX ON TX/LONG RANGE.

MODEL 1600
MODEL 2400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A-120A
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BT-101
FURUNO
S-103
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S-102
S-104
BT-102
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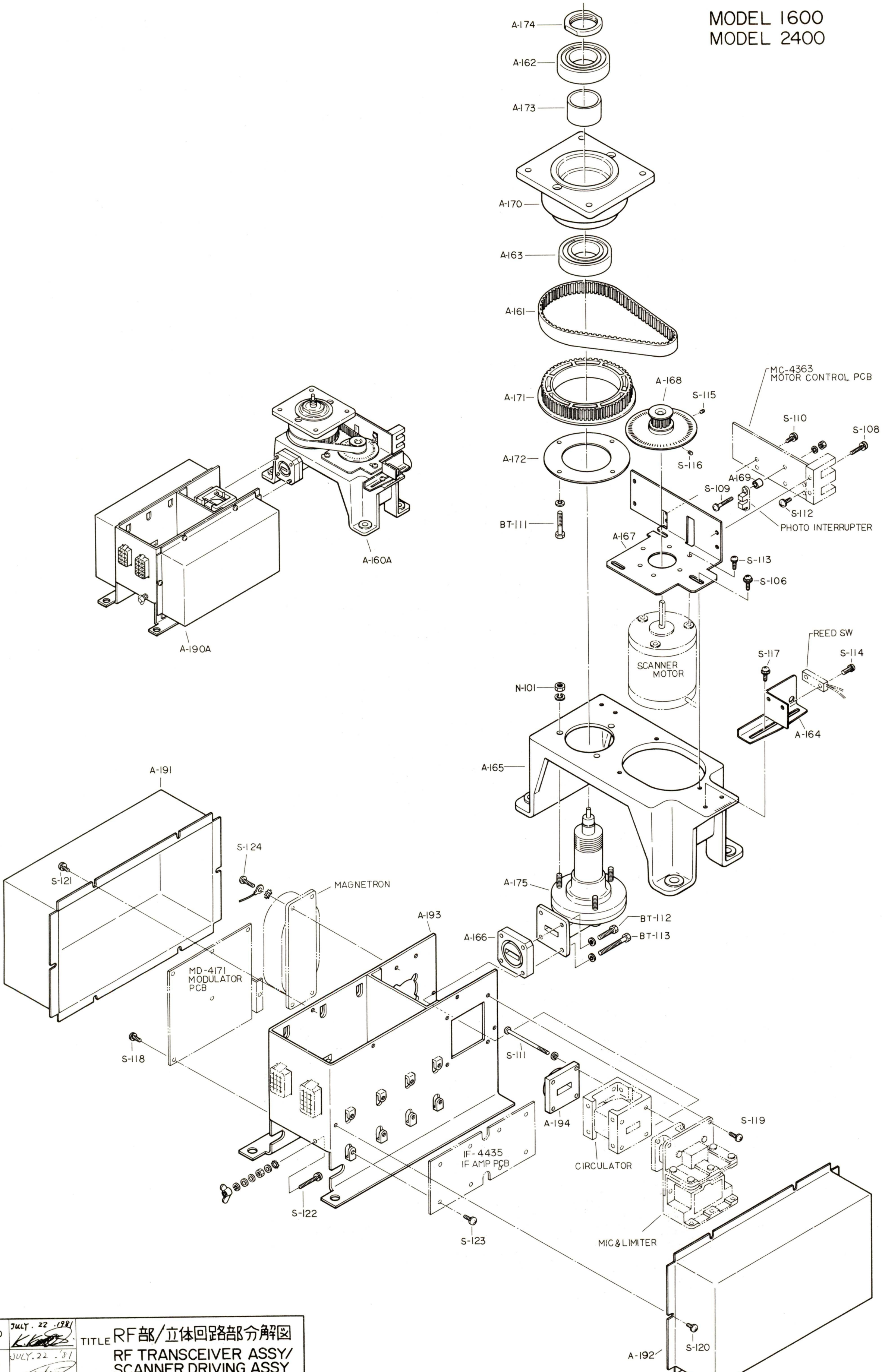
A-102
A-110 A
A-131
A-133
A-130A
A-132
S-105
A-134
BT-103
A-111
S-107
BT-104
A-160A
A-190A
BT-106
BT-107
BT-109
A-144
A-141
A-143
A-142
A-151
A-149
A-148
A-103
A-152
A-140 A
BT-110
A-150
BT-108
A-145
A-146
BT-105
A-147

APPROVED	JULY. 23 .1981	TITLE	空中線部分解図 SCANNER UNIT
CHECKED	JULY. 22 .'81		
DRAWN	22nd. July. 1981	DWG. NO.	C3248-008-B

MODEL 1600
MODEL 2400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A-170
A-163
A-161
A-171
A-168
S-115
MC-4363
MOTOR CONTROL PCB
S-110
S-108
A-172
S-116
A-169
S-109
S-112
PHOTO INTERRUPTER
BT-111
A-167
S-113
S-106
A-160A
A-190A
SCANNER
MOTOR
REED SW
S-117
S-114
N-101
A-164
A-165
A-191
S-124
MAGNETRON
S-121
A-175
BT-112
A-193
A-166
BT-113
MD-4171
MODULATOR
PCB
S-118
S-111
A-194
S-119
IF-4435
IF AMP PCB
CIRCULATOR
S-122
S-123
MIC&LIMITER
A-192
S-120

APPROVED	JULY. 22 .1981	TITLE	RF部/立体回路部分解図 RF TRANSCEIVER ASSY/ SCANNER DRIVING ASSY
CHECKED	JULY. 22 .'81		
DRAWN	2nd. July .1981	DWG. NO.	C3248-009-B

PART 3

SYSTEM MAINTENANCE & TROUBLESHOOTING

CONTENTS

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1-2. Cleaning and Lubrication 1-1

CHAPTER 2. TROUBLESHOOTING 2-1 to 2-17

2-1. Trouble Tracing Chart 2-1
2-2. Troubleshooting 2-3

CHAPTER 1. SYSTEM MAINTENANCE

1-1. General

The radar system should maintain optimum performance for a reasonably long period of time. Factory adjustment or alignment of circuits does not require frequent readjustments and realignments. However, continued performance can not be expected without periodic inspection and maintenance.

Periodically, a thorough inspection of the equipment should be made. Cable connections at terminal boards and connectors should be kept clean and tight. Be sure all ground connections are secure and properly grounded. Arrange all wires and cables in orderly manner to prevent the possibility of arc-over or short. Replace all wires that show signs of corrosion, cracking or deterioration.

All units of the equipment should be kept clean and free from corrosion. Replace all missing knobs and defective or broken parts. Housing, shields, covers and other protective devices should be at their proper place and secured.

1-2. Cleaning and Lubrication

Cleaning lengthens the operating life of the equipment. Dirt on components can result in shortcircuits. A dry, soft cloth and soft bristled brush are recommended for removing dirt from the outside of the unit. Dirt on the inside of the unit should be removed with a soft-bristled brush and removed by using an electric cleaner.

Hardened dirt should be removed by using a mild detergent and water solution on a cotton-tipped swab or a soft cloth. Avoid excessive use of water. Do not allow water to penetrate any parts. Avoid the use of abrasives and chemical agents.

Corroded areas should be cleaned with a neutralizing solution of 2% borax and water to prevent further corrosion.

CAUTION:

After cleaning, the sets should be carefully inspected for defects such as poor connections, damaged parts and loosened mechanical parts.

Keep all moving parts properly lubricated using a cleaning-type lubricant on shaft bushings. Do not overlubricate.

Period	Item	Actions
Every visit to the ship	Plugs and jacks	Check that plugs and jacks are firmly fitted.
	CRT screen and bearing/cursor plate	Clean up CRT surface and bearing/cursor plate as follows by using soft cloth with slight amount of anti-static-charge spray. Never apply plastic solvent. 1. Remove the display cursor panel. 2. Clean up CRT surface and bearing/cursor plate with special care not to make scratch mark.
	Deflection coil mechanism	1. Clean up the slip ring board with soft dry cloth. 2. Check movement of deflection coil, and clean up gears if required. Note: Do NOT apply oil onto the coil turning gear.
	Scanner unit	Check for dirt or crack on the radome surface. Thick dirt should be wiped out by using soft cloth immersed with fresh water. If any crack is found, apply slight amount of sealing compound or adhesive. If necessary, replace it with new one.
Every half a year	Scanner motor	1. Check carbon brushes. If they are worn away or abnormal spark is seen, replace the brushes with new ones. 2. Clean commutators with soft dry cloth.
Every year	CRT anode	High tension on CRT attracts dust in environment, and moist dust will cause poor insulation. Clean up high voltage parts as follows. 1. Turn off radar. 2. Pull out anode cap and touch its nipple to chassis (discharging). 3. Clean up anode cap/lead by using soft dry cloth. Note 1. If any crack is found on rubber cap or wire sheath, replace it with new one. 2. Never fail to put anode cap back to CRT after cleaning.

CHAPTER 2. TROUBLESHOOTING

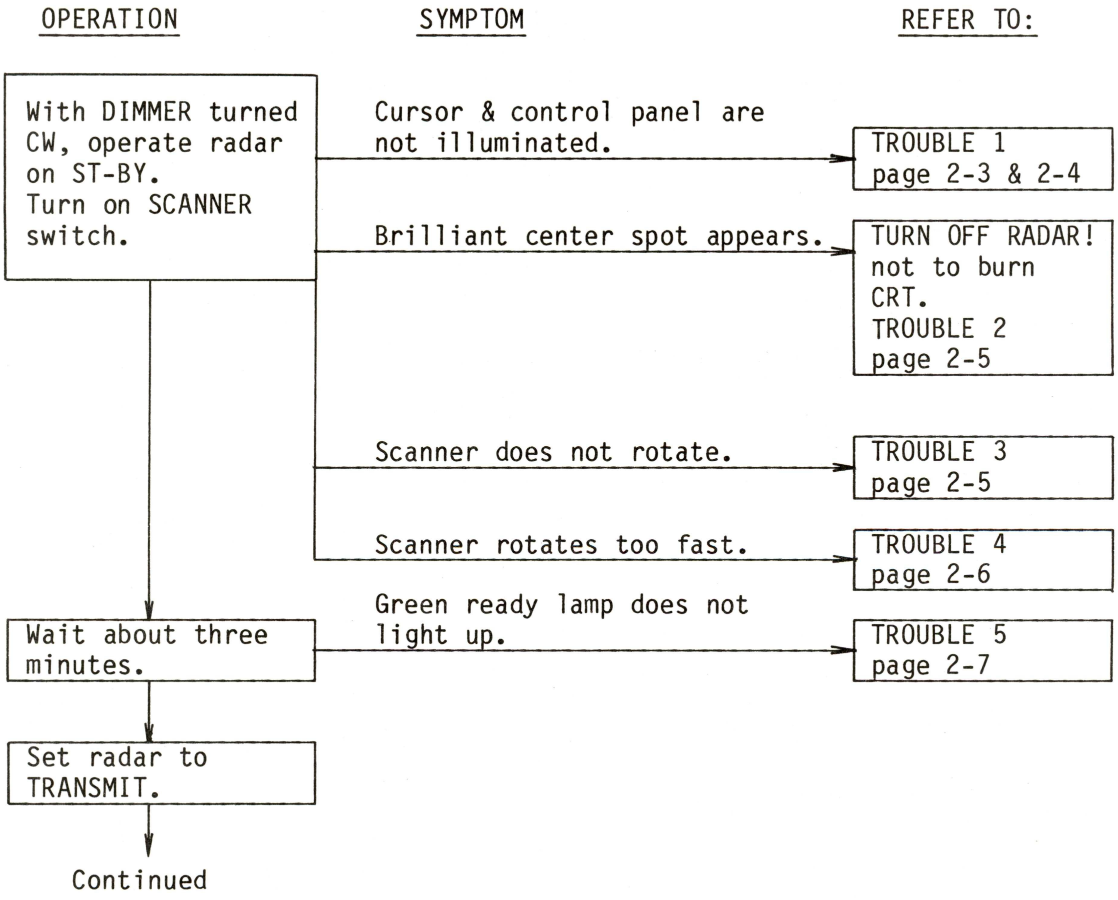
2-1. Trouble Tracing Chart

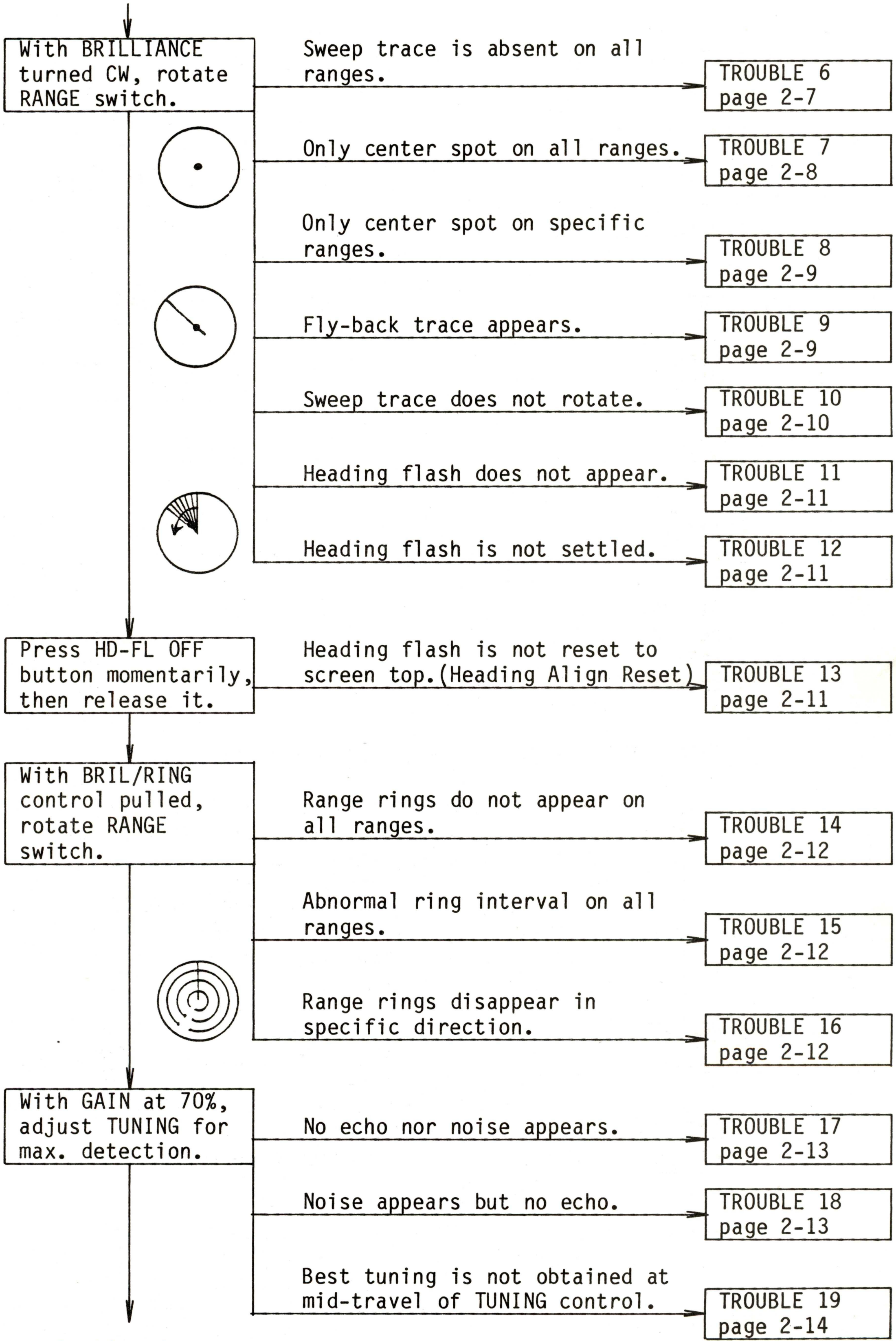
To facilitate the procedure for trouble tracing, the following flowchart is arranged. After trouble is traced down to a certain "trouble", proceed to the "2-2. Troubleshooting" for further information.

Initial Checks:

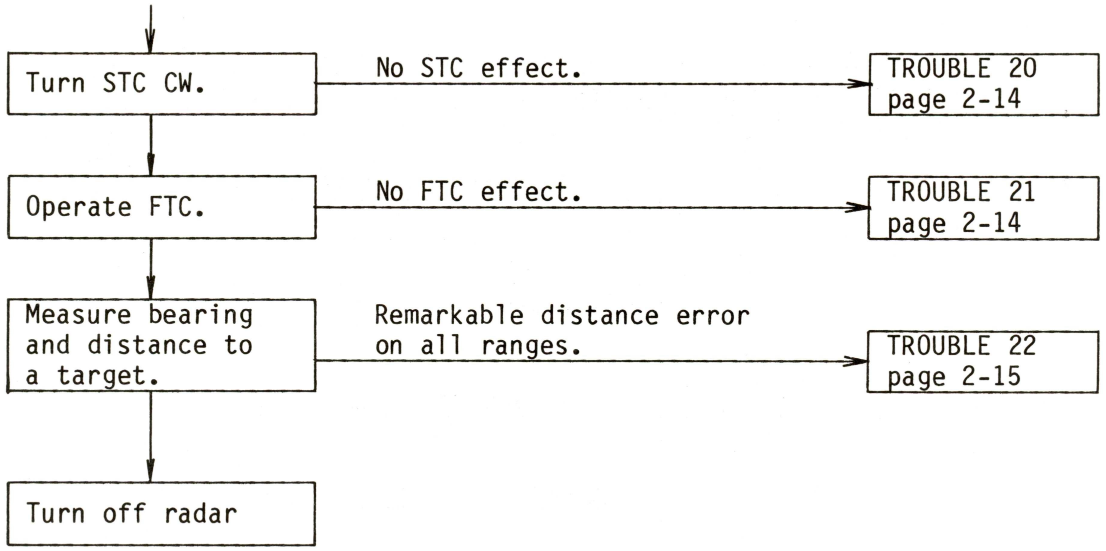
1) Place the front panel controls and switches as shown right.
2) Check the input voltage and polarity between J1351 #1 (+) and #2 (-).

CONTROLS	POSITIONS
FUNCTION	OFF
RANGE	Maximum Range
TUNING	Mid-travel
OTHERS	Fully CCW


OPERATION
SYMPTOM
REFER TO:
With DIMMER turned CW, operate radar on ST-BY. Turn on SCANNER switch.
Cursor & control panel are not illuminated.
TROUBLE 1 page 2-3 & 2-4
Brilliant center spot appears.
TURN OFF RADAR! not to burn CRT. TROUBLE 2 page 2-5
Scanner does not rotate.
TROUBLE 3 page 2-5
Scanner rotates too fast.
TROUBLE 4 page 2-6
Wait about three minutes.
Green ready lamp does not light up.
TROUBLE 5 page 2-7
Set radar to TRANSMIT.
Continued


With BRILLIANCE turned CW, rotate RANGE switch.
Sweep trace is absent on all ranges.
TROUBLE 6 page 2-7
Only center spot on all ranges.
TROUBLE 7 page 2-8
Only center spot on specific ranges.
TROUBLE 8 page 2-9
Fly-back trace appears.
TROUBLE 9 page 2-9
Sweep trace does not rotate.
TROUBLE 10 page 2-10
Heading flash does not appear.
TROUBLE 11 page 2-11
Heading flash is not settled.
TROUBLE 12 page 2-11
Press HD-FL OFF button momentarily, then release it.
Heading flash is not reset to screen top.(Heading Align Reset)
TROUBLE 13 page 2-11
With BRIL/RING control pulled, rotate RANGE switch.
Range rings do not appear on all ranges.
TROUBLE 14 page 2-12
Abnormal ring interval on all ranges.
TROUBLE 15 page 2-12
Range rings disappear in specific direction.
TROUBLE 16 page 2-12
With GAIN at 70%, adjust TUNING for max. detection.
No echo nor noise appears.
TROUBLE 17 page 2-13
Noise appears but no echo.
TROUBLE 18 page 2-13
Best tuning is not obtained at mid-travel of TUNING control.
TROUBLE 19 page 2-14

Continued


Turn STC CW.
No STC effect.
TROUBLE 20 page 2-14
Operate FTC.
No FTC effect.
TROUBLE 21 page 2-14
Measure bearing and distance to a target.
Remarkable distance error on all ranges.
TROUBLE 22 page 2-15
Turn off radar

NOTE: Display general circuit diagram on page 2-17 will help you to carry out Line Voltage Check.

2-2. Troubleshooting

Trouble 1. Cursor and front panel are not illuminated.

Cause:
- * Main fuse F1351 blown. (See Fig.2-10.)
- * Illumination lamps DS51 thru DS55 and associated circuit defective. (See Fig.2-10.)
- * Shortcircuit on DC line.
- * Power transistor Q1304 thru Q1307 shorted. (See Fig.2-11.)
- * Power transformer T1 cut off or shorted. (See Fig.2-11.)
- * 25kHz PWM inverter faulty.
- * 25kHz inverter faulty.

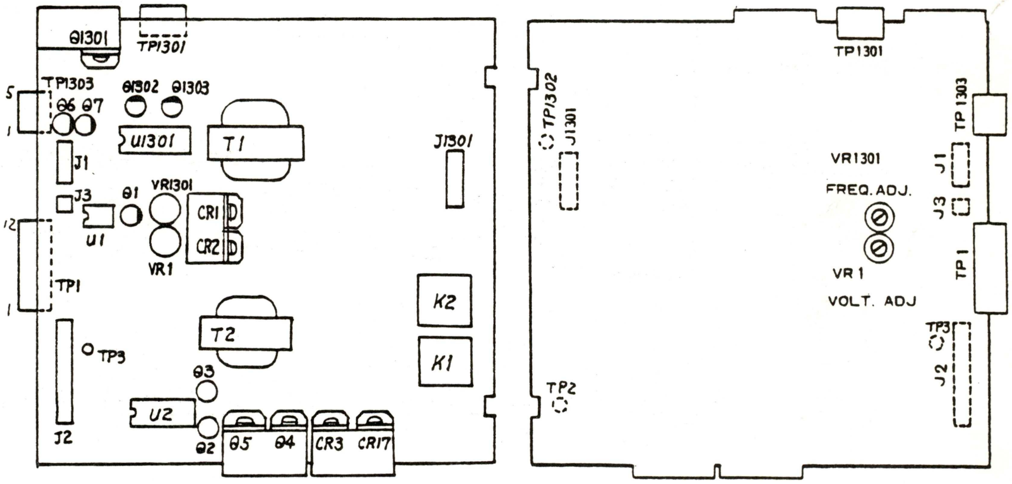
Check/Remedy:

1) Check if fuse F1351 is blown. If it is blown, replace it with new one (10A). Then, operate the radar and check the fuse again. If new fuse is blown again, inverter output transistors (Q1304 thru Q1307), 9V regulator (Q1301) or power transformer (T1) are defective. (Note: Incorrect polarity of power supply also blows the fuse F1351.)

2) Measure the DC voltage between TP-1 #9 (+) and #8 (-) on PT-4906 board by DC30V voltmeter. See Fig.2-1. If the meter reads approx. 7.3V, the inverter and rectifier circuits are operating normally. Check the illumination lamps DS51 thru DS55 and the associated circuit (VR51, P1, P51, P54, P55 & P56).

3) If fuse F1351 is alive, it is considered that the protector circuit is operating. Remove three connectors P1, P2, P3 and connect a jumper wire between pin #1 and #2 of J1. Then, check the DC voltage between TP1 #6 (+) and #4 (-) by DC30V voltmeter. See Fig.2-1. If the meter reads approx. 11.8V, this trouble is caused by shortcircuit on DC lines.

Voltage Check Points	Ratings
TP1303 #3 (+) & #4 (-)	8V to 9V
TP1 #1 (-) & #4 (+)	-187V to -255V
TP1 #3 (-) & #4 (+)	-11.4V to -12.6V
TP1 #5 (+) & #4 (-)	4.75V to 5.25V
TP1 #6 (+) & #4 (-)	11.68V to 11.92V
TP1 #7 (+) & #4 (-)	30V to 35V
TP1 #9 (+) & #8 (-)	6.84V to 7.56V
TP1 #12(+) & #4 (-)	140V to 150V (1/4M) 38V to 42V (1 1/2M) 12V to 15V (12M)
TP1 #10(+) & #4 (-)	69.3V to 76.7V
TP3 (+) & TP1 #4 (-)	300V to 340V


Q1301
TP1301
TP1303
5
1
Q1302
Q1303
Q6
Q7
U1301
T1
J1301
J1
J3
Q1
VR1301
CR1
CR2
U1
VR1
12
TP1
1
K2
T2
K1
TP3
Q3
U2
J2
Q2
Q5
Q4
CR3
CR17
TP1301
TP1302
J1301
TP1303
VR1301
FREQ. ADJ.
J1
J3
VR 1
VOLT. ADJ
TP1
TP3
J2
TP2

a) Parts Side

b) Soldering Side

Fig.2-1 POWER SUPPLY Board (PT-4906)

Trouble 2. Brilliant center spot appears in ST-BY.

Cause:
- * Faulty CRT.
- * Defective -220V line on DISPLAY MAIN board.
- * Defective -100V regulator (CR502 thru CR504) on DISPLAY MAIN board.

Check/Remedy:

1) TURN OFF RADAR! in order not to burn CRT. Then, remove P501, P502, P503 from DISPLAY MAIN board. See Fig.2-2.

2) Restart the radar and check the grid-cathode bias voltage of CRT by connecting a DC voltmeter between J503 #5 (neg) and chassis (pos). Normally it is greater than 100V d.c. If the bias voltage is alive there, CRT is defective.

3) If no or very low bias voltage is measured, check -220V line at J52 #1 and -100V regulator diodes CR502 thru CR504 shown in Fig.2-2.

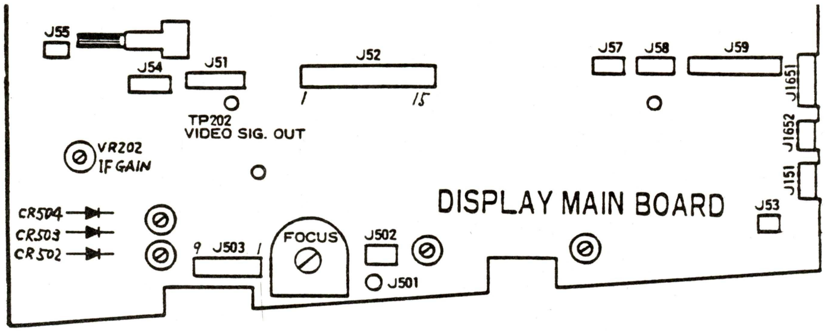

J55
J54
J51
J52
1
15
J57
J58
J59
J1651
J1652
J151
TP202
VIDEO SIG. OUT
VR202
IF GAIN
CR504
CR503
CR502
9
J503
1
FOCUS
J502
J501
DISPLAY MAIN BOARD
J53

Fig.2-2 Brilliance Circuit on DISPLAY MAIN Board

Trouble 3. Scanner does not rotate.

Cause:
- * Fuse F1352 blown. (See Fig.2-10.)
- * Defective scanner rotating mechanism (Bearing A-162/163 jammed or Timing belt A-161 cut off. Refer to Dwg. No. C3248-009 on page D-2 in PART 2.)
- * Scanner motor B801 faulty. (See Fig.2-12.)
- * Poor connection between scanner and display units.
- * MOTOR CONTROL board (MC-4363) defective.

Check/Remedy:

1) Check if fuse F1352 is blown.
If it is blown, replace it with new one (1A). Then, check if the fuse is blown again.

2) If the fuse is blown again, the scanner rotating mechanism is jammed or the scanner motor is shorted. Rotate the antenna radiator by hand. If the radiator does not rotate smoothly, remove the radiator assembly from scanner driving assembly. Then, replace the defective bearing (A-162/163) with new one. If the radiator rotates smoothly, the scanner motor or MOTOR CONTROL board MC-4363 is shorted.

3) Check if the timing belt for scanner driving assembly is cut off. If it is cut off, replace it with new one and adjust the tension referring to section 2-4 in PART 2.

4) Check the DC voltage between #3(+) and #1(-) of J931 (Scanner Motor Voltage) on MOTOR CONTROL board MC-4363. See Fig.2-3. Normal reading is approx. 2.2V. If no voltage is applied, MC-4363 board is faulty.

5) If approx. 14V is measured, the scanner motor is defective (open circuit).

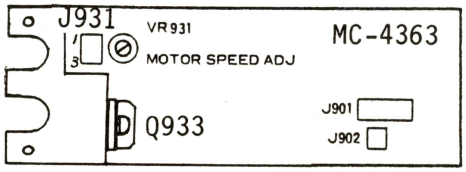


Fig.2-3 MC-4363 Board

Trouble 4. Scanner rotates too fast. (Only for MODEL2400)

Cause: * MOTOR CONTROL board (MC-4363) defective.

Check/Remedy

1) Check the voltage between J931 #3(+) and #1(-). If it is nearly 24V, Q933 is shorted. See Fig.2-3.

2) If the voltage is about 14V, other components or MOTOR CONTROL board (MC-4363) are defective.

Trouble 5. Green ready lamp does not light up.

Cause:
- * +5V line is off.
- * Faulty timer circuit U111.
- * Defective green ready lamp (LED) CR401.

Check/Remedy:

1) Check that +5V is applied between P52 #8(+) and #6(-) on the DISPLAY MAIN board. If not, check the continuity between J2 on PT-4906 board and J52 on DISPLAY MAIN board by ohmmeter.

2) Check that the lamp drive voltage (+4V to +5V) is applied between U111 pin #8 (+) and GND (-) on DU-4591 board. If the drive voltage is applied, the LED CR401 or its associated circuit is defective. See Fig.2-4.

3) If the voltage at U111 pin #8 stays at 0V, timer IC U111 is faulty. See Fig.2-4.

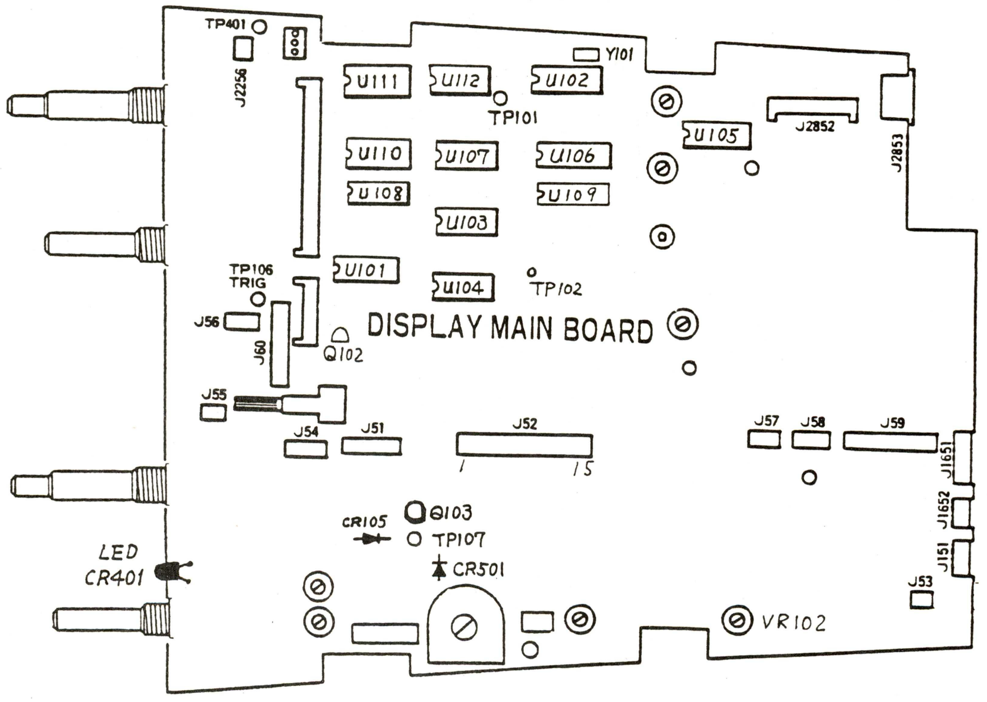

TP401
J2256
U111
U112
U102
Y101
TP101
J2852
U105
J2853
U110
U107
U106
U108
U109
U103
TP106
TRIG
U101
U104
TP102
J56
J60
DISPLAY MAIN BOARD
Q102
J55
J54
J51
J52
1
15
J57
J58
J59
J1651
J1652
J151
J53
CR105
Q103
TP107
CR501
LED
CR401
VR102

Fig.2-4 Timebase & Unblanking Circuit on DISPLAY MAIN Board

Trouble 6. Sweep trace is absent on all ranges.

Cause:
- * CRT heater cut off.
- * Faulty CRT high voltage supply.
- * Faulty timebase circuit (U101 thru U104 & Y101)
- * Faulty sweep timing circuit (U106)
- * Faulty sweep duration circuit (U105, U107, U110, U112)
- * Faulty unblanking circuit (Q103, CR105)
- * +75V line cut off

Check/Remedy

1) Check the voltage at TP101 on the DISPLAY MAIN board. See Fig.2-4. Normal reading is approx 2V d.c. If it is either 0V or 5V, reference oscillator (Y101 and U102) is defective.

2) Check the voltage at TP102. Normal reading is about 2V d.c. If it is 0V or 5V, timebase (U101, U103 & U104) is defective.

3) Check the voltage at the pin #8 of U110. Normal reading in short ranges is 0.7V approx. If it is 0V or 5V, sweep timing circuit (U106) or sweep duration circuit (U105, U107, U110 & U112) is faulty.

4) Turning the FUNCTION switch between TRANSMIT and ST-BY, measure the voltage at TP107. Normal reading is approx. -130V d.c. If the voltage changes in different settings of FUNCTION switch, the unblanking circuit is working normally. Check if CR501 is shorted. Then, check visually the CRT heater is lit. Check also the CRT anode voltage by the following method.

   * Switch off the radar and pull out the CRT anode cap with special care, then approach it to chassis. If normal, a sparking occurs at 5 to 10 mm separation.

5) If the voltage at TP107 does not change in different settings of FUNCTION switch, check the voltage at Q103 emitter. Normal reading is approx. 3V in TRANSMIT and 0V in ST-BY. If it is approx. 55V, Q103 is shorted.

Trouble 7. Only Center Spot on all ranges

Cause:

* Defective deflection coil.
* Faulty deflection transistor Q106.
* Defective deflection power supply.
* Faulty sweep circuit;
  U115 thru U118, Q104/Q105, Q108 thru Q110.
* Faulty +12V or -12V line.

Check/Remedy:

1) In different settings of the RANGE switch, check the voltage at J53 #1. (Deflection Power Supply). See Fig.2-5. Normal reading is

   140V to 150V (¼M)
   38V to 42V (1-½M)
   12V to 15V (12M)

2) Ensure the line voltages of +12V and -12V are applied at J52 #9 (+12V) and #3 (-12V) respectively.

3) Measure the voltage at J151 #4. If no voltage is applied, check the continuity of the deflection coil and brushes. Then, check if Q106 is shorted.

4) Check the voltage or waveform at pin #6 of U116. Normal voltage is approx. -0.2V. The waveform is shown in the schematic diagram. If it is not in order, sweep circuit U115, U116, U118, Q104, Q109 or Q110 is faulty.

5) Check the voltage or waveform at pin #6 of U117. Normal voltage is about 0.3V. If it is not in order, U117 or Q108 is defective.

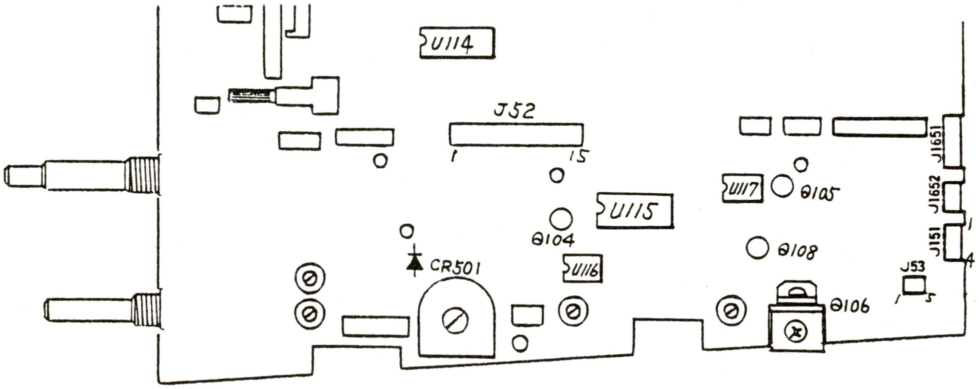


Fig.2-5 Sweep Circuit on DISPLAY MAIN Board

Trouble 8. Only center spot on specific range(s).

Cause: * Faulty deflection power supply circuit
* Relays K1/K2 and associated circuit are defective.

Check/Remedy 1) Changing the range, check if relays K1 and K2 operate as below. See Fig.2-1 for the location of K1 and K2.

1/4 and 1/2 n.m. ranges:	K1 OFF, K2 ON
1-1/2 thru 6 n.m. ranges:	K1 ON, K2 OFF
12 n.m. range and above:	K1 OFF, K2 OFF

2) If the relay does not operate, relay itself or its drive circuit Q6, Q7 or U114 is defective.

3) If the relay operates normally, check if resistor R11, R12 or R13 is cut off.

Trouble 9. Fly-back trace appears.

Cause: * Defective diode CR501 on DISPLAY MAIN board.

Check/Remedy: 1) Switch off the radar. Then check the diode CR501 with multimeter set to ohm range. See Fig.2-5.

Trouble 10. Sweep trace does not rotate.

Cause:
- * Defective deflection coil drive motor B1651.(See Fig.2-10.)
- * Faulty auto heading alignment circuit on DISPLAY MAIN board.
- * Defective heading flash key S801. (See Fig.2-12.)
- * Faulty bearing signal generator on MC-4363 board. (See Fig.2-12.)
- * Poor connection between scanner and display units.

Check/Remedy: 1) Check if the drive voltage is applied to the deflection motor B1651. Measure the voltage between chassis (-) and pins #3, #4, #5 and #6 of J1651 (+) on DISPLAY MAIN board with a multimeter set at AC30V range. If the meter reads 10V to 15V in all pins, the auto heading alignment circuit is good. Check deflection motor B1651.

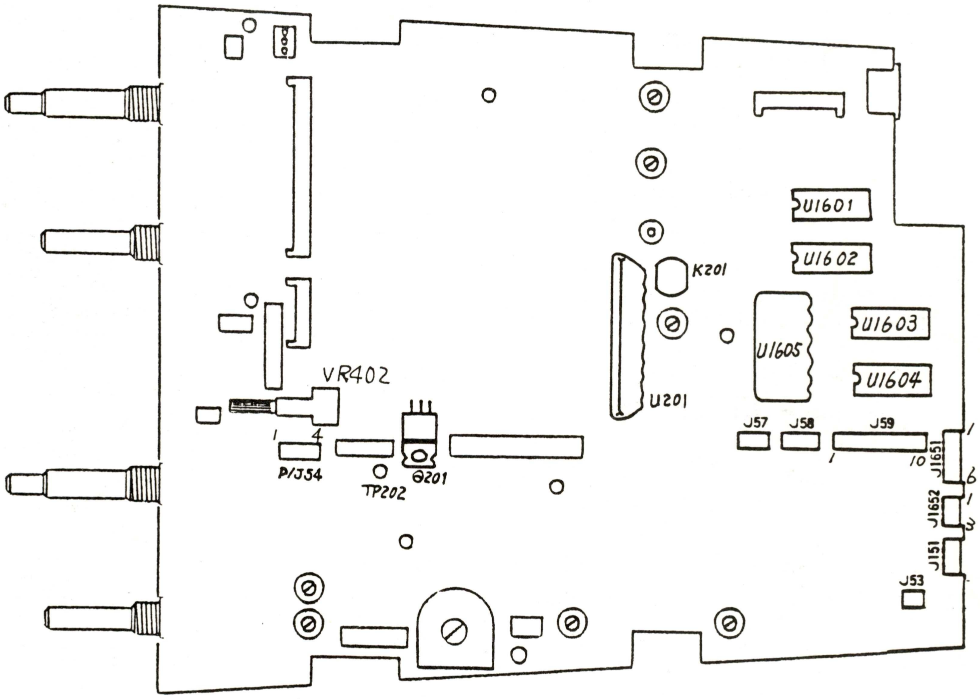


Fig.2-6 Auto Heading Alignment Circuit on DISPLAY MAIN Board

2) If the drive voltage is not applied, check if the bearing and heading signals are applied from the scanner unit to the display unit.

For the heading flash checking, connect the multimeter set at DC30V between #8(+) and #9(-) of P/J59. In normal operation, the meter swings from +12V to +1V when the heading flash key S801 in closed. If the meter indication stays at 12V d.c., heading flash key S801 in the scanner unit is defective or the connection between the heading flash key and the display unit is cut off.

3) For the bearing signal checking, connect the multimeter, set at AC30V, between P/J59 #7 and #9. In normal operation, the meter reads about 11V a.c. If not, the bearing signal generator or photo interrupter U901 on MC-4363 board in the scanner unit is defective or the connection between scanner and display units is off.

4) If both the heading flash and bearing signal are normal, the auto heading alignment circuit (U1601 thru U1605) is defective.

Trouble 11. Heading flash does not appear.

Cause:
- * Faulty video amplifier on DISPLAY MAIN board.
- * HD-FL OFF switch defective.

Check/Remedy:

1) With the RANGE RING switch turned on, confirm that range rings are displayed. If not, the video amplifier (U201 & Q201) is defective. See Fig.2-6.

2) Check +12V heading flash power supply between #4(+) and #3(-) of P/J54 on DISPLAY MAIN board with a multimeter set at DC30V range. See Fig.2-6. If not, replace the HD-FL OFF switch.

Trouble 12. Heading flash is not settled.

Cause:
- * Timing disc for bearing signal (in the scanner unit) is defective or masked by dust.
- * Deflection coil drive gear assembly defective.

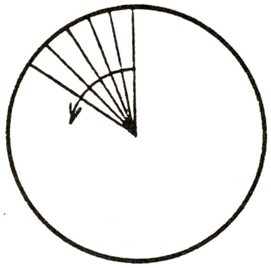


Fig.2-7

Check/Remedy:

1) Check visually the timing disc holes.

2) Check the deflection coil drive gears.

Trouble 13. Heading Flash is not reset to screen top. (Heading Align Reset)

When the HD-FL OFF switch is depressed (HD-FL OFF/HEADING ALIGN RESET), the sweep trace should stop at screen top once, then, start rotation when the antenna radiator faces dead ahead.

Cause:
- * Faulty photo interrupter U1651. (See Fig.2-10.)
- * Defective IC (U1601 & U1602) on DISPLAY MAIN board.

Check/Remedy:

1) If the sweep trace does not stop at screen top, check the function of photo-interrupter U1651. Connect a multimeter set at DC30V range between P/J1652 #2(+) and #3(-). See Fig.2-6.

2) If the meter reading drops from 12V to 0V at the interval of one rotation of deflection coil, the photo-interrupter is normally operating. Check ICs U1601 and U1602. See Fig.2-6.

Trouble 14. Range rings do not appear on all ranges.

Cause: *Faulty video amplifier (U201 and Q201).
*Faulty range ring circuit (U106 and U108).

Check/Remedy 1) If heading flash is also absent, check transistor Q201 and IC U201 on DISPLAY MAIN board. See Fig.2-6.

2) If heading flash appears, check ICs U106 and U108. See Fig.2-4.

Trouble 15. Abnormal ring interval on all ranges.

Cause: * CRT anode voltage varied.
* Faulty sweep circuit.

Check/Remedy: 1) If abnormal number of range rings (with same interval each other) appear on all ranges as shown in Fig.2-8(a), check if the CRT high voltage is within 7.5kV to 8.5kV.

2) If the CRT high voltage is within ratings, adjust the sweep velocity potentiometer VR102 (Fig.2-4.) referring to section 2-5 in PART 1.

3) If the range ring intervals differ as the distance increases on all ranges as shown in Fig.2-8(b), the sweep circuit is faulty.

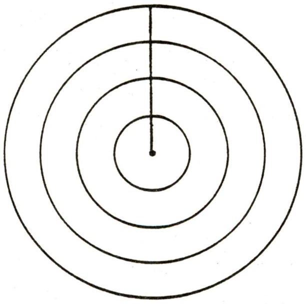


Fig.2-8(a)

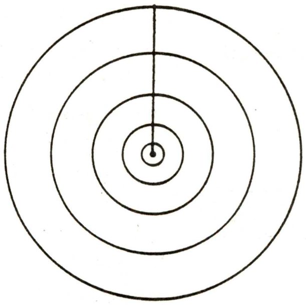


Fig.2-8(b)

Trouble 16. Range rings disappear in specific direction.

Cause: * Poor contact between slip ring and brush.

Check/Remedy 1) Clean the slip ring.

2) If the slip ring is scratched deeply by the brush, replace both the slip ring and brushes and adjust the brush contact referring to section 3-5 in PART 1.

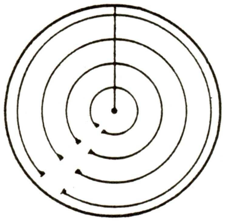


Fig.2-9

Trouble 17. No echo nor noise appears.

Cause:
- * Defective video amplifier
- * Discontinuity or shortcircuit of coaxial cable.
- * Faulty IF amplifier.

Check/Remedy: 1) Remove video input plug P201. Then, connect the multimeter, set at DC3V range, between center pin (-) and outer shield (+) of plug P201.

2) With the STC turned fully CCW, turn the GAIN between extremes. If the meter reading varies with respect to the setting of the GAIN, IF amplifier and coaxial cable are O.K. Check the video amplifier on DISPLAY MAIN board.

3) If the meter reading does not vary, check the continuity of the coaxial cable between the display and scanner units.

4) Then check the IF amplifier

Trouble 18. Noise appears but no echo.

Cause:
- * Fuse F1 (0.5A) blown. (See Fig.2-10.)
- * Modulator SCR CR803 shorted. (See Fig.2-12.)
- * Defective trigger generator circuit
- * Modulator trigger circuit faulty.
- * Magnetron heater voltage not applied.
- * Magnetron defective.
- * Faulty IF amplifier

Check/Remedy: 1) Check fuse F1 (0.5A) is blown. If it is blown, replace it. Then, restart radar in stand-by. If the fuse is blown again, SCR CR803 or pulse forming network is shorted. Check them with multimeter in ohm range.

2) If fuse F1 is not blown, check the magnetron current by measuring the voltage at P801 #3 (See page 2-2 in PART 2.) on the RF transceiver assembly. Normal reading is 1.3V to 2.4V or 1.8V to 2.4V on short or long range respectively.

3) With the FUNCTION switch set at ST-BY, check the magnetron heater voltage between the terminals #4(pos) and #6(neg) of the pulse transformer T801. (See Fig.2-12.) In normal operation, the magnetron heater voltage is DC6.0V to DC6.6V.

4) Check the voltage and waveform at TP106 on DISPLAY MAIN board (See Fig.2-6.). Normal voltage reading is approx. 3V on 1/4 n.m. range.

*If the voltage at TP106 is fixed at 0V, Q102 (See Fig.2-6.) is shorted.
*If it stays at 12V, U109, U107 or U101 (See Fig.2-6.) is defective.

5) If the magnetron current is normal, check the voltage at P/J614 #9 (See Fig.2-12.) "Di MONITOR" on the RF transceiver assy. It should be within ± 20% of the voltage indicated on mixer U801. If it is within the rating, the IF amplifier is defective. Replace whole the IF amplifier assembly.

Trouble 19. Best tuning is not obtained at mid-travel of TUNING control.

Cause: * Frequency deviation of magnetron.

Check/Remedy: 1) Adjust tuning preset VR402 on DISPLAY MAIN board. (See Fig.2-6.)

NOTE: ALLOW ABOUT 20 TO 30 MINUTES AFTER SWITCHING ON THE RADAR FOR WARMING UP THE MAGNETRON.

Trouble 20. No STC effect.

Cause: * STC circuit faulty.

Check/Remedy: 1) Check the STC waveform at TP602 on the IF AMPLIFIER board in the scanner unit. (See Fig.2-12.)

2) Check the trigger waveform between P/J611 #4 and #3. (See Fig.2-12.)
Normal waveforms are shown in the schematic diagram.

Trouble 21. No FTC effect.

Cause; * Faulty FTC circuit in the video amplifier.

Check/Remedy: 1) Check the FTC circuit in the first stage of the video amplifier.

Trouble 22. Remarkable distance error on all ranges.

Cause: * Frequency deviation of reference oscillator Y101.

Check/Remedy: 1) Replace crystal Y101. See Fig.2-4.

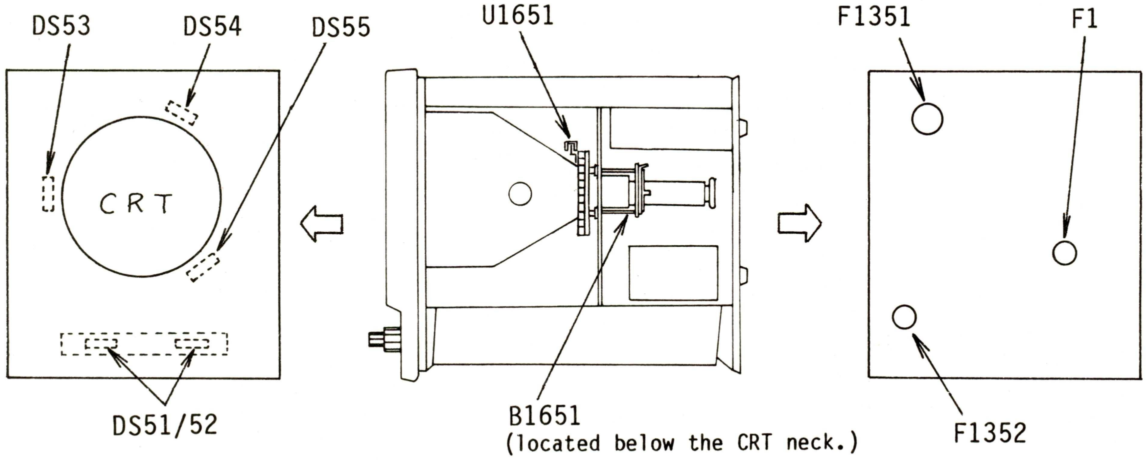

DS53
DS54
DS55
CRT
DS51/52
U1651
B1651
(located below the CRT neck.)
F1351
F1
F1352

Fig.2-10 Display Unit

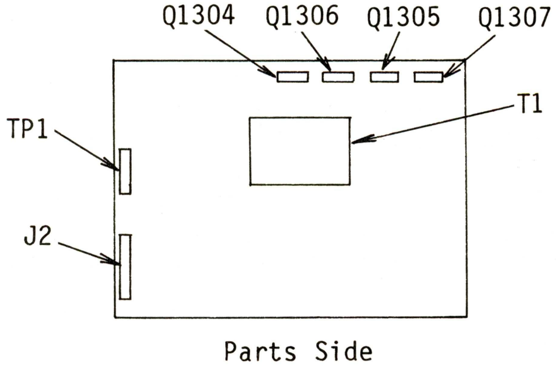

Q1304
Q1306
Q1305
Q1307
T1
TP1
J2
Parts Side

Fig.2-11 POWER SUPPLY Board

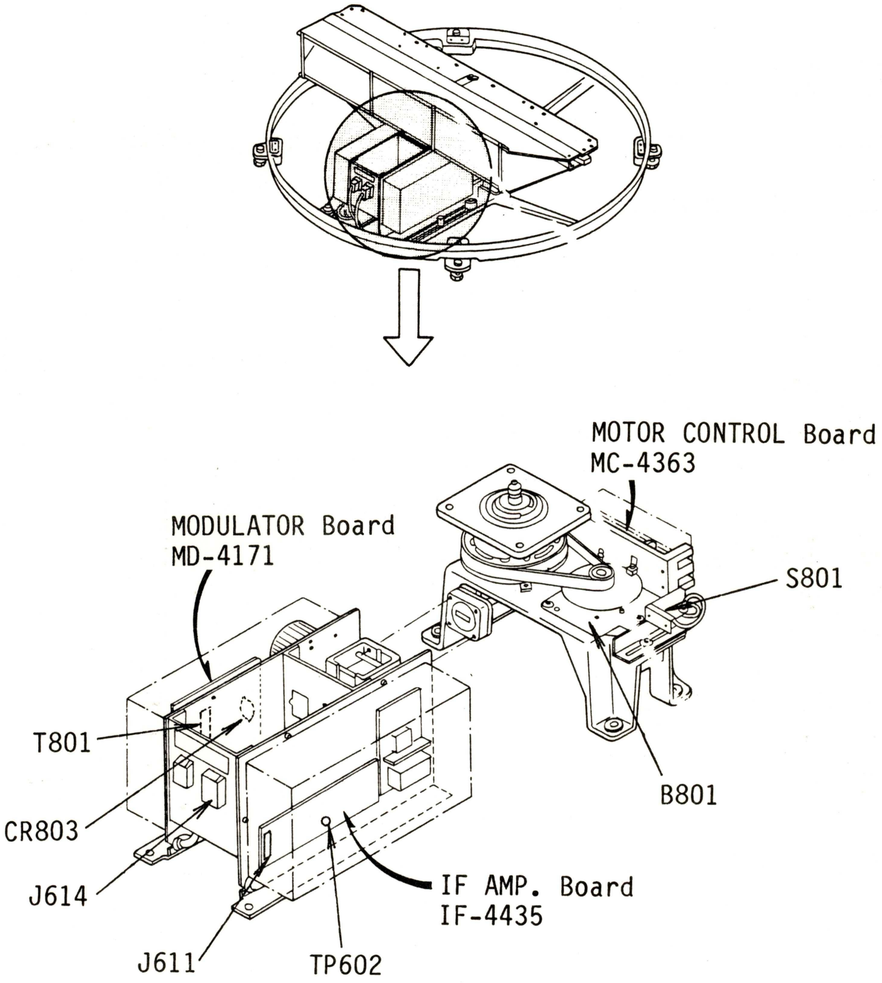
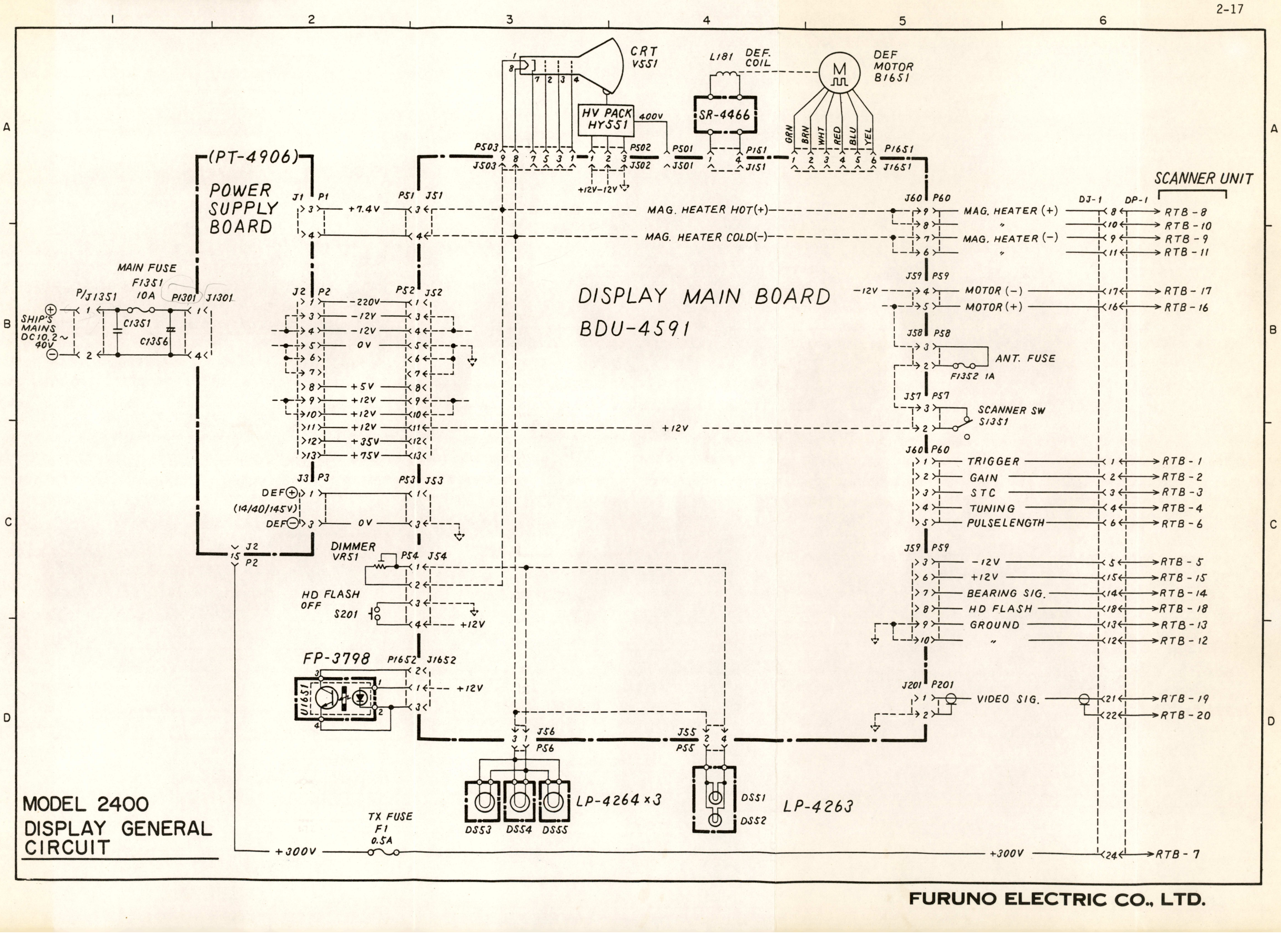

MOTOR CONTROL Board
MC-4363
MODULATOR Board
MD-4171
S801
T801
CR803
B801
J614
IF AMP. Board
IF-4435
J611
TP602

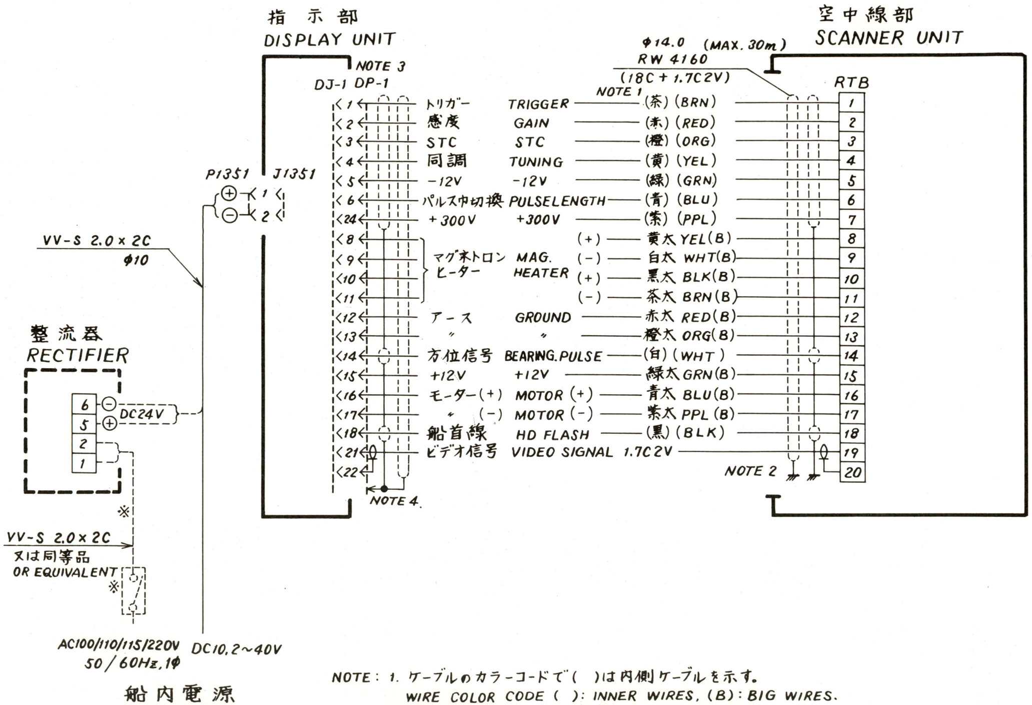
Fig.2-12 Scanner Unit



1
2
3
4
5
6
A
B
C
D
CRT V551
L181 DEF. COIL
DEF MOTOR B1651
M
HV PACK HY551
400V
SR-4466
GRN
BRN
WHT
RED
BLU
YEL
P503
J503
P502
J502
P501
J501
P151
J151
P1651
J1651
+12V -12V
(PT-4906)
POWER SUPPLY BOARD
J1
P1
P51
J51
+7.4V
MAG. HEATER HOT(+)
MAG. HEATER COLD(-)
J60
P60
MAG. HEATER (+)
MAG. HEATER (−)
DJ-1
DP-1
SCANNER UNIT
RTB-8
RTB-10
RTB-9
RTB-11
MAIN FUSE F1351 10A
P/J1351
P1301
J1301
C1351
C1356
SHIP'S MAINS DC10.2~40V
J2
P2
P52
J52
-220V
-12V
-12V
0V
+5V
+12V
+12V
+12V
+35V
+75V
DISPLAY MAIN BOARD BDU-4591
J59
P59
-12V
MOTOR (−)
MOTOR (+)
RTB-17
RTB-16
J58
P58
ANT. FUSE
F1352 1A
J57
P57
SCANNER SW S1351
+12V
TRIGGER
GAIN
STC
TUNING
PULSELENGTH
RTB-1
RTB-2
RTB-3
RTB-4
RTB-6
J3
P3
P53
J53
DEF⊕
(14/40/145V)
DEF⊖
0V
-12V
+12V
BEARING SIG.
HD FLASH
GROUND
RTB-5
RTB-15
RTB-14
RTB-18
RTB-13
RTB-12
J2
P2
15
DIMMER VR51
P54
J54
HD FLASH OFF
S201
+12V
FP-3798
P1652
J1652
U1651
+12V
J201
P201
VIDEO SIG.
RTB-19
RTB-20
J56
P56
J55
P55
LP-4264×3
DSS3
DSS4
DSS5
DSS1
DSS2
LP-4263
TX FUSE F1 0.5A
+300V
+300V
RTB-7

MODEL 2400
DISPLAY GENERAL CIRCUIT

FURUNO


指示部
DISPLAY UNIT
NOTE 3
DJ-1 DP-1
1 トリガー TRIGGER
2 感度 GAIN
3 STC STC
4 同調 TUNING
5 −12V −12V
6 パルス巾切換 PULSELENGTH
24 +300V +300V
8 9 10 11 マグネトロン ヒーター MAG. HEATER
12 アース GROUND
13 〃 〃
14 方位信号 BEARING.PULSE
15 +12V +12V
16 モーター(+) MOTOR (+)
17 〃 (−) MOTOR (−)
18 船首線 HD FLASH
21 ビデオ信号 VIDEO SIGNAL 1.7C2V
22
NOTE 4.
空中線部
SCANNER UNIT
φ14.0 (MAX. 30m)
RW 4160
(18C + 1.7C2V)
NOTE 1
(茶) (BRN)
(赤) (RED)
(橙) (ORG)
(黄) (YEL)
(緑) (GRN)
(青) (BLU)
(紫) (PPL)
(+) 黄太 YEL(B)
(−) 白太 WHT(B)
(+) 黒太 BLK(B)
(−) 茶太 BRN(B)
赤太 RED(B)
橙太 ORG(B)
(白) (WHT)
緑太 GRN(B)
青太 BLU(B)
紫太 PPL (B)
(黒) (BLK)
RTB
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
NOTE 2
P1351 J1351
1 2
VV-S 2.0 × 2C
φ10
整流器
RECTIFIER
6 5 2 1
DC24V
※
VV-S 2.0 × 2C
又は同等品
OR EQUIVALENT
※
AC100/110/115/220V
50 / 60Hz, 1φ
DC10.2〜40V
船内電源
SHIP'S MAINS

NOTE: 1. ケーブルのカラーコードで( )は内側ケーブルを示す。
WIRE COLOR CODE ( ): INNER WIRES, (B): BIG WIRES.
2. 空中線部側のシールドは完全にアースすること。
SHIELD SHOULD BE EFFECTIVELY GROUNDED AT SCANNER UNIT.
3. コネクタープラグ取付済。 CONNECTOR PLUG FACTORY-WIRED.
4. シールドはコネクターケースを通してアースされている。
SHIELD GROUNDED THRU CONNECTOR CASE.
5. ※ 造船所支給 SHIPYARD SUPPLY.

MODEL 2400

承認 APPROVED	AUG. 25. '82
検図 CHECKED	AUG. 24. '82
製図 DRAWN	Aug. 24. '82

品番 ITEM	品名 NAME	材質 MATERIAL	数量 Q'TY	図番 DWG.NO.	摘要 REMARKS

THIRD ANGLE PROJECTION 三角法

尺度 SCALE /

重量 WEIGHT kg

名称 TITLE 相互結線図 INTERCONNECTION DIAGRAM

図番 DWG.NO. C3255-002-B

FURUNO ELECTRIC CO., LTD.

Recommended Spare Parts List

*1:DEPOT MAINTENANCE PARTS FOR 10 SETS IN 2 YEARS
*2:SHIPBORNE RUNNING PARTS FOR 1 SET IN 2 YEARS

NAME OF PARTS	TYPE	CODE NO.	QUANTITY		REMARKS
			*1	*2	
MAGNETRON	9M302/E3513	000-101-730	2		
CIRCULATOR	FCX-62	000-105-424	1		FR-240 M3/FR-360 M2
CIRCULATOR	RC-4356	000-106-860	1		MODEL 2400 ONLY
DIODE LIMITER	S-LX5B(S)	000-107-088	1		
MIC ASSEMBLY	RU-3684 W/SLX5B (S)	008-316-490	1		
CRT	180SB7	000-103-600	1		
TRANSISTOR	2SA467GTM-O	000-116-930	6	2	
TRANSISTOR	2SA495GTM-O	000-116-992	6	2	
TRANSISTOR	2SA495GTM-Y	000-116-993	3	1	
TRANSISTOR	2SA715C	000-117-430	3	1	
TRANSISTOR	2SA743A-C	000-117-466	3	1	
TRANSISTOR	2SA778-K	000-117-520	3	1	
TRANSISTOR	2SA1020-Y	000-118-050	3	1	
TRANSISTOR	2SB434Y	000-120-871	3	1	
TRANSISTOR	2SB595-O	000-121-103	3	1	MODEL 2400 ONLY
TRANSISTOR	2SC367GTM-O	000-123-552	6	2	
TRANSISTOR	2SC372GTM-Y	000-123-561	6	2	
TRANSISTOR	2SC606(B)T	000-123-915	3	1	
TRANSISTOR	2SC752GTM-O	000-124-129	3	1	
TRANSISTOR	2SC945	000-124-420	6	2	
TRANSISTOR	2SC1569	000-125-117	3	1	
TRANSISTOR	2SC2334,6,K	000-126-152	6	2	
TRANSISTOR	2SC2837-O	000-126-302	3	1	
DIODE	05Z5.1X	000-110-804	3	1	
DIODE	1SS106	000-112-019	3	1	
DIODE	1S1588	000-112-795	24	8	
DIODE	1S2095A	000-113-046	3	1	
DIODE	1S2462	000-113-090	6	2	
DIODE BRIDGE	CTG-22R	000-132-440	3	1	
DIODE BRIDGE	CTG-22S	000-132-441	3	1	
BRIDGE DIODE	CTU-22S	000-132-446	3	1	
DIODE	MA26WO-B	000-133-739	3	1	
ZENER DIODE	RD-6.8FB	000-134-800	3	1	
ZENER DIODE	RD10EB	000-134-816	3	1	
DIODE	RD-6.2EB1	000-134-833	3	1	
DIODE	RD-9.1EB1	000-134-835	3	1	
ZENER DIODE	RD22EB	000-134-840	3	1	
ZENER DIODE	RD30EB	000-134-855	3	1	
ZENER DIODE	RD33EB	000-134-860	3	1	
DIODE	SB2	000-135-012	3	1	
DIODE	U06C	000-135-901	3	1	
DIODE	DFG-1B8	000-136-013	3	1	
DIODE	DFG1B15	000-136-017	3	1	
DIODE	V19E	000-136-020	6	2	
IC	M5186P	000-150-284	1		

NAME OF PARTS	TYPE	CODE NO.	QUANTITY		REMARKS
			*1	*2	
IC	MB3759M	000-157-500	1		
IC	UPC-157C	000-161-031	1		
IC	UPC595C	000-161-060	1		
IC	HA17902P	000-162-082	1		MODEL 2400 ONLY
IC	HD74LS04P	000-162-404	2		
TTL IC	HD74LS11P	000-162-411	1		
IC	HD74LS26P	000-162-426	1		
TTL IC	HD74LS27P	000-162-427	1		
IC	HD74LS73P	000-162-473	1		
TTL IC	HD74LS132P	000-162-485	1		
IC	HD74LS148P	000-162-492	1		
IC	HD74LS151P	000-162-510	1		
IC	HD74LS161P	000-162-516	2		
IC	HD74LS221P	000-162-530	1		
IC	HD74LS393P	000-162-580	1		
IC	TA7555P	000-163-007	1		MODEL 2400 ONLY
IC	TD62004P	000-163-091	1		
IC	TC4011BP	000-163-245	2		
IC	TC4027BP	000-163-251	1		
IC	TC-4051BP	000-163-257	1		
IC	TA78L005AP	000-163-606	1		
HI-MIC	RC-4210-1	000-164-253	1		
HI-MIC	RC-4211	000-164-254	1		
HI-MIC	RC-4232-2	000-164-256	1		
IC	TL081CP	000-168-486	1		
IC	MC14538BCP	000-170-016	2		
C-MOS IC	MC14541BCP	000-170-018	1		
RESISTOR/CAPACITOR PACK	RC-4214-1	000-378-100	1		
LED	LN353P	000-133-609	3	1	
PHOTO INTERRUPTER	ON-1102	000-134-100	3	1	
PHOTO INTERRUPTER	ON1105	000-134-102	3	1	
PHOTO COUPLER	PS2001B-M	000-134-355	1		
THERMISTOR	D-22A	000-180-617	3	1	
ZNR	ERZ15D3K221	000-132-669	3	1	
SCR	S6080B	000-135-000	3	1	
REED SWITCH	NRS-109	000-478-020	3	1	MODEL 2400 ONLY
REED SWITCH	RS-1	000-478-301	3	1	FR-240 M3/FR-360 M2
POTARY SWITCH	RR-4592	000-460-345	1		FR-360 M2 ONLY
ROTARY SWITCH	RR-4600	000-460-350	1		MODEL 2400/FR-240 M3
ROTARY SWITCH	RR-4265-1	000-634-265	1		
TOGGLE SWITCH	ST-206N	000-470-067	1		
RELAY	MR31-12HD	000-454-080	1		
RELAY	HC1-P-DC12V	000-454-521	1		
RELAY	SCD2A	000-458-150	1		
RELAY	RRS51A12	000-455-198	1		

NAME OF PARTS	TYPE	CODE NO.	QUANTITY *1	QUANTITY *2	REMARKS
CRYSTAL	CSA2.59MA1	000-491-030	1		
PULSE MOTOR	SM40-4806-C DC12V	000-431-452	1		
MOTOR	OSR-F DC24V	000-432-000	1		MODEL 2400 ONLY
SCANNER MOTOR	RM-3622 10W	000-633-622	1		FR-240 M3/FR-360 M2
CARBON BRUSH	12-3-3249-2	000-633-249	4	14	FOR DEF. COIL
LAMP	T3.8C-8V-60MA	000-540-180	30	10	
GLASS TUBE TYPE FUSE	F-1065, 0.5A	000-547-004	30	10	
GLASS TUBE TYPE FUSE	F-7161, 1A	000-547-006	30	10	
GLASS TUBE TYPE FUSE	F-7161, 10A	000-547-015	30	10	
HIGH VOLTAGE PACK	RU-3679-2	000-633-678	2		
PRINTED CIRCUIT BOARD	SR-4466	000-634-466	2		
PRINTED CIRCUIT BOARD	IF-4435-3	003-037-540	1		FR-240 M3/FR-360 M2
PRINTED CIRCUIT BOARD	MD-4171	003-037-550	1		MODEL 2400
PRINTED CIRCUIT BOARD	MC-4363-3	003-037-570	1		MODEL 2400
PRINTED CIRCUIT BOARD	FP-3798	003-114-250	1		
PRINTED CIRCUIT BOARD	LP-4263	003-114-270	1		
PRINTED CIRCUIT BOARD	LP-4264	003-114-280	2		
PRINTED CIRCUIT BOARD	BDU4591	003-114-570	1		MODEL 2400/FR-240 M3
PRINTED CIRCUIT BOARD	PT4906	003-114-630	1		
PRINTED CIRCUIT BOARD	CDU4591	003-114-790	1		FR-360 M2 ONLY
MODULATOR TRIGGER PCB	ARF-4476,MOD TRIG	008-316-380	1		FR-240 M3/FR-360 M2
PRINTED CIRCUIT BOARD	MD-3576-4, MOD	008-316-390	1		FR-240 M3/FR-360 M2
PRINTED CIRCUIT BOARD	MP-3648-1,BRG SIG	008-353-540	1		FR-240 M3/FR-360 M2
TRANSFORMER *PULSE*	RT-3072	000-733-072	1		FR-240 M3/FR-360 M2
TRANSFORMER	RT-4098	000-734-098	2		
PULSE TRANSFORMER	RT-4484	000-734-484	1		
TRANSFORMER	RT-4589	000-734-589	1		
TRANSFORMER	RT-4942	000-734-942	1		
DEFLECTION COIL ASSEMBLY	RL-4485-1	003-113-330	1		
RESISTOR PACK	RC-4208-1	000-378-104	1		
RESISTOR PACK	EXB-H89811G	000-379-100	1		
CARBON POTENTIOMETER	EVMR0GS20B17	000-307-750	1		FOCUS
CARBON POTENTIOMETER	RGP102-501	000-316-250	1		VOLT.ADJ
CARBON POTENTIOMETER	RGP102-202	000-316-256	1		MOTOR SPEED, LIMITER
CARBON POTENTIOMETER	RGP102-502	000-316-259	1		FREQ.ADJ
CARBON POTENTIOMETER	RGP102-103	000-316-260	1		SWEEP TIMIG, SWEEP VELOCITY, RANGE RING TIMING
CARBON POTENTIOMETER	RGP102-503	000-316-261	1		BRILL. PRESET
CARBON POTENTIOMETER	RGP102-204	000-316-267	1		BRILL. PRESET
POTENTIOMETER	GFP06B	000-316-805	1		
DUAL VR W/SWITCH	RV-4267-1	000-319-057	1		TUNING & BRILL
DUAL VR W/SWITCH	RV-4268-1	000-319-058	1		GAIN & STC
VR W/SWITCH	RV-4270-1	000-319-059	1		DIMMER
CORBON POTENTIOMETER	RV-4269	000-319-062	1		TUNING PRESET
TIMING BELT	150 X L037G	000-841-127	3	1	MODEL 2400 ONLY
BEARING	6006ZZ PS2	000-873-233	1		MODEL 2400 ONLY
RADOME UPPER ASSEMBLY	C1P9N2N	003-037-600	1		MODEL 2400 ONLY
PACKING FOR DOME	03-003-3204-2	300-332-042	1		MODEL 2400 ONLY
TIMING DISK W/ GEAR	03-003-3232-1	300-332-321	1		MODEL 2400 ONLY